RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Duodenal Ulcer in Children[1]

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Germantown, Penna.

THE POSSIBILITY of an inflammatory lesion of the duodenal bulb is not considered frequently enough in the differential diagnosis of gastro-intestinal tract upsets or abdominal pain in children. For one to suspect ulcer in children presenting symptoms referable to the abdomen or gastro-intestinal tract, it is essential to accept the fact that ulcer can and does occur. The purpose of this paper is to cite some significant observations from the literature regarding duodenal ulcer and to present a series of illustrative case histories and roentgenograms of the lesion in children.

Thiele (1) reported a series of 248 cases of ulcer in children sixteen years old or younger, half of which were duodenal in location.

Hirsch (2), in a very large collected series of peptic ulcer, reported the incidence in children to be between 0.3 and 1.0 per cent, but did not distinguish between duodenal and gastric lesions.

Cockovic (3) showed that more than 18 per cent of his cases of ulcer presented clinical symptoms developing between the ages of ten and twenty years.

Proctor (4), in an analysis of 1,000 duodenal ulcers in adults, found 26 cases with symptoms dating back to childhood.

Bird and his associates (5), in a careful search of the literature, discovered 119 cases of peptic ulcer in infants and children verified by operation, together with 124 cases in which the diagnosis was established by postmortem or x-ray studies. In this group of 243 cases, there were approximately 160 duodenal ulcers.

Berglund (6) reported an analysis of 1,323 postmortem examinations in children up to thirteen years of age, in 14 of which duodenal ulcer was demonstrated.

Benner (7) in 500 routine autopsies in children reported an incidence of duodenal ulcer of 1.4 per cent.

Michaëlsson (8) reported an incidence of duodenal ulcer of 1.5 per cent.

The true incidence of duodenal ulcer in children is difficult to evaluate. From scattered autopsy statistics, it would appear to vary from 1 to 1.5 per cent. This would seem to be a very significant percentage, for we know that autopsy statistics based on hospitalized patients do not represent the true incidence of a disease for any age group of the population, but only for that percentage with complications severe enough to require hospital admission.

This would suggest that the true incidence of duodenal ulcer in children is much higher and that clinically it should be suspected more frequently and procedures instituted to prove or disprove its presence.

This report is based on an x-ray study of the gastro-intestinal tract in 254 children

[1] From the Department of Radiology, Fitzgerald-Mercy Hospital, Darby, Penna. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

in the routine work of an x-ray department in a general hospital and in private office practice. In this number of examinations, the x-ray diagnosis of duodenal ulcer was made 30 times. The oldest patient in whom ulcer was diagnosed was fourteen years of age, while the youngest was two years of age. Twelve of the patients were girls, with the following age distribution: 2 of two years, 2 of three, 2 of eight, 2 of nine, and 4 of eleven years. Among the 18 boys were 2 of four years, 4 of five, 2 of seven, 2 of eight, 4 of eleven, 2 of thirteen, and 2 of fourteen years.

ETIOLOGY

There would seem to be a significant relationship between the development of ulcer in the gastro-intestinal tract and severe cutaneous burns or disease of the central nervous system. Cushing (9) reported the development of multiple ulcers of the stomach and duodenum, frequently with perforation, following brain surgery, especially operations upon the cerebellum. This suggests that the brain stimulation or injury which could accompany prolonged labor or difficult delivery with instrumentation might explain the occurrence of acute ulcer in the immediate neonatal period. Other than the above, the etiology is not clear-cut.

Guthrie (10), in an excellent review of the literature, suggests vascular occlusion or spasm as a result of birth trauma as being a likely cause of ulcer in the newborn. Shore (11) feels that over-distention of the stomach and duodenum by large feedings, or perhaps by gas, may play a significant role.

Hurst and Stewart (12) suggest that ulcer may be produced by bacterial toxins from elsewhere in the body and cite the frequent development of ulcer after acute exanthemata or following uremia, upper respiratory infection, or some other infection. It is of interest to note that in one of the cases studied in this series symptoms of ulcer developed following an attack of osteomyelitis.

The attempts of Rivers (13) and of Robinson (14) to classify ulcers according to clinical types of individuals is of doubtful value in explaining the etiology of ulcer in childhood, and the factors of nervousness, worry, strain, and over-indulgence in food, alcohol, or tobacco would seem to play little, if any, part in the production of ulcer in patients of this age. That some process or group of factors causes a change in the lining of the bowel wall, which allows the acid gastric juice and pepsin to destroy the mucosa, is widely believed, and Miller's (15) report on initial high concentration of gastric acid during the first twenty-four hours of life lends credence to this idea. The great number of factors which are known to cause ulcer in man and in experimental animals suggests that there is no common etiology, and the problem in children as in adults is as yet unsolved.

TECHNIC OF EXAMINATION

The technic of the x-ray examination of the stomach and duodenum in children is similar to that for adults. The patient is first examined in the erect posture, with a preliminary fluoroscopic screening of the chest and abdomen. Particular attention is paid to the presence or absence of a fluid level or an unusual amount of stomach gas, which would suggest pyloric spasm. This is a significant finding, for many of the cases have shown a high degree of spasm of the pylorus during the early part of the examination. This usually relaxes somewhat after administration of the barium meal. After the screening, the patient is given a glass of tap-water barium sulfate suspension containing 4 ounces of barium in 6 ounces of water. Occasionally it is necessary to add a small amount of chocolate flavoring to the barium to encourage the younger patients to drink the mixture. Fluoroscopic studies are then completed.

A muslin restraining band is then gently tightened over the abdomen so as to hold the patient quiet, and spot and full films are made of the stomach and pyloro-duodenal region, while various degrees of pressure are applied with a balsa wood com-

Fig. 1. Twenty-day-old infant brought into the hospital with symptoms of regurgitation of most feedings for the past few days. Vomitus at first contained greenish mucus; later bright red blood. A profuse intestinal hemorrhage occurred and the child died. Autopsy revealed a perforated duodenal ulcer on the posterior wall. Illustration shows section taken through the perforated ulcer.

pression cone. The pyloro-duodenal region is easily visualized in children, but it is necessary that it be thoroughly studied on the screen and reproduced on the films to enable one to diagnose or exclude the possibility of an inflammatory lesion of the duodenal bulb. The right oblique anterior erect and prone projections will give a very satisfactory delineation of this area. The spot films are made without the Bucky diaphragm, at 75 kv.p., 50 ma., 20 inches distance, with the time varying between one-twentieth and two-tenths of a second, depending upon the patient's size. Suspension of respiration is desirable but not always attainable, and at times it is quite difficult to secure satisfactory films of younger children for this reason.

X-RAY APPEARANCE OF THE LESION

An active duodenal ulcer in children is usually manifested by the presence of an ulcer niche associated with irritability of the duodenal bulb. It is only rarely that one sees the hour-glass, half-bulb, cloverleaf, or pine-tree type of deformity which is so frequently seen in duodenal ulcers in adults. The greater degree of bulbar deformity is usually found in the pre-adolescent patient with symptoms similar to the adult ulcer syndrome of longer duration. The irritability of the duodenal cap and the intermittent pyloric spasm during the early part of the examination are very prominent features. Frequently the bulb is so markedly non-retentive, and throws the barium off so rapidly, that the niche cannot be demonstrated. The use of a balsa wood compression cone will often enable one to catch a small amount of barium in the erosion and demonstrate it on the screen and films. After the niche has once been filled, and more and more barium has passed through the pylorus and bulb, the

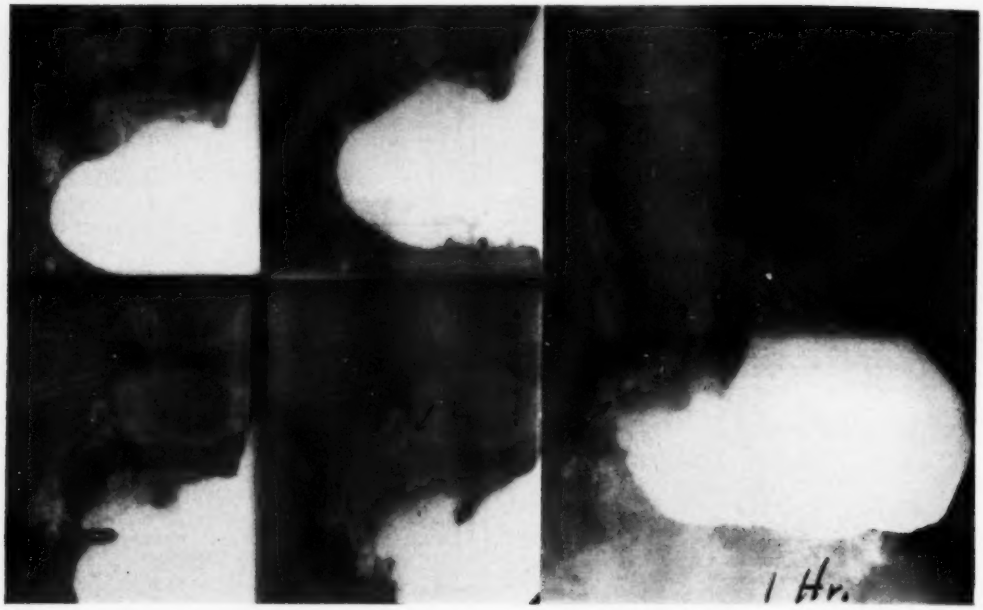

Fig. 2A. Nine-year-old boy with symptoms of abdominal pain, just to left of midline, of many months duration, with much nausea and vomiting, chronic constipation, and anorexia. There is marked duodenal deformity with a niche. Gastric clearance was delayed due to duodenal irritability and pylorospasm. Niche well shown at the hour examination, which also shows delayed gastric emptying.

intensity of the pyloric spasm and the irritability of the bulb may lessen and visualization become easier. At this time, more satisfactory demonstration of the inflammatory process in the duodenal bulb becomes possible. It is well to wait for this period of lessened irritability before spot films are made.

Not all patients with pronounced pyloric spasm or with marked irritability and nonretentiveness of the bulb will show a niche defect, yet the type of irritability of the bulb is very striking and similar in character to those cases showing a typical niche. Actually, there may be present in such cases a small, shallow, superficial mucosal erosion, not sufficiently deep to collect enough barium to render it demonstrable as a niche on the screen or on the film. In many of these cases, the clinical symptoms as well as the response to conservative medical regime is such that a presumptive diagnosis of ulcer is frequently made. This finding is suggestive of the diagnosis of duodenitis of the type described by Rivers. No case without a definite niche defect is included in this series.

SYMPTOMS

In Bird's analysis of his cases, he found bleeding, perforation, stenosis, and pain, in that order of frequency, in patients up to two years of age, with bleeding and perforation being particularly common. Ulcers in the newborn and in the neonatal period are usually associated with melena and symptoms of perforation and collapse. The symptoms, as a rule, are so precipitous, with no premonitory signs, that death occurs before the diagnosis is made or therapeutic measures are instituted. There have been two cases in the hospital within the neonatal period presenting symptoms of gross bleeding of this acute nature, with collapse and death, that showed perforated duodenal ulcer at autopsy. The patients in Bird's series in the age group from two to six years inclusive showed bleeding as the most common symptom, while the group from seven to fifteen inclusive pre-

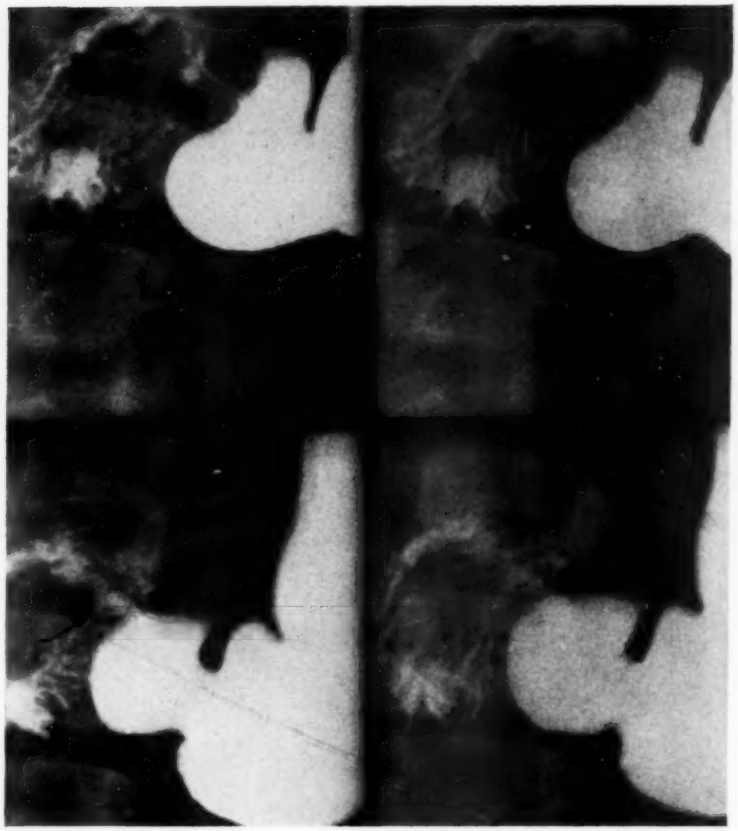

Fig. 2B. Patient has been on a conservative medical regime for nine months, with some relief of pain and vomiting. Co-operation is not satisfactory and numerous dietary breaks occur, with exacerbations of symptoms. X-ray studies still reveal much bulbar irritability and deformity.

sented symptoms of stenosis, perforation, and pain in that order of frequency. It is interesting to note that bleeding becomes much less common beyond the age of two years. The symptoms presented by Bird's patients are not necessarily typical for the disease as such, for a high percentage of his cases were surgical, with operation for complications of ulcer. Proctor feels that many patients give a long history of abdominal distress, vomiting, and constipation, while Shore believes that ulcers in children give symptoms which may be typical or quite bizarre. Holt's (16) early paper on duodenal ulcer in children reported no characteristic symptoms in one-third of his cases.

The most prominent symptoms in the series here reported were abdominal pain, usually generalized but occasionally periumbilical or epigastric in origin, together with gastric upset manifested by nausea and vomiting. Symptoms of weight loss and constipation were infrequent. Blood in the vomitus and stool was found in 3 patients. The adult ulcer patient's symptom complex of "pain, food, ease" was not apparent. The abdominal pain was frequently described as an ache that was difficult to localize and had been previously diagnosed as mesenteric adenitis, food allergy, or a gastro-enteritis based on a dietary indiscretion. In 3 patients, it was thought to be due to appendicitis, for which

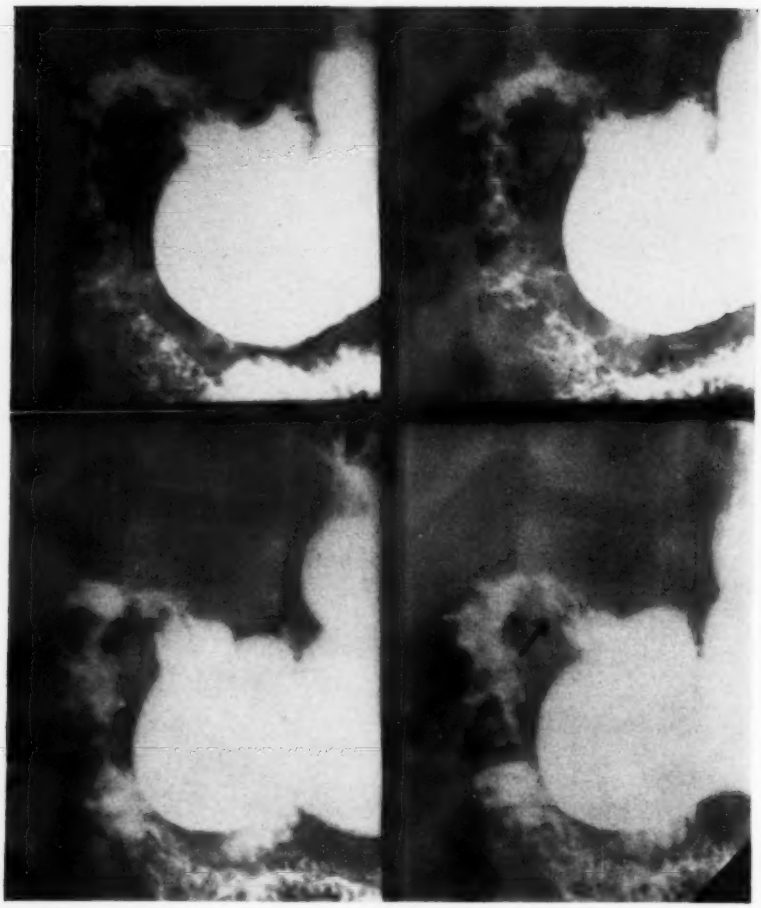

Fig. 3A. Five-year-old girl with history of nocturnal pain, nausea, and vomiting, frequently relieved by warm milk and crackers; intermittent for many months. The child had been treated for parasites. Deep segmenting gastric peristalsis prominent. Duodenal bulb with niche defect well shown.

surgery had been done. The episodes of nausea and vomiting were frequently quite severe and usually caused the patient and the family much distress. During these attacks, the anorexia was usually associated with weight loss and constipation. The vomiting was suggestive of the type associated with pyloric spasm, the symptoms disappearing once the stomach had been emptied.

The more or less lack of localization of the pain of ulcer in children, compared to the usual upper abdominal localization in adults, is difficult to explain unless it is due to the characteristics of the ulcer. In children, the erosion is shallow and superficial and ordinarily has not invaded beyond the mucosa. In those of Bird's cases showing a duodenal ulcer of the adult type, the symptom complex was also adult in type.

Laboratory findings were generally of little significance. Physical examination revealed occasional abdominal tenderness.

PATHOLOGY

Both Bird and Holt state that ulcers in the newborn occur so rapidly that there is no evidence of inflammatory or bacterial invasion adjacent to or in the ulcer bed.

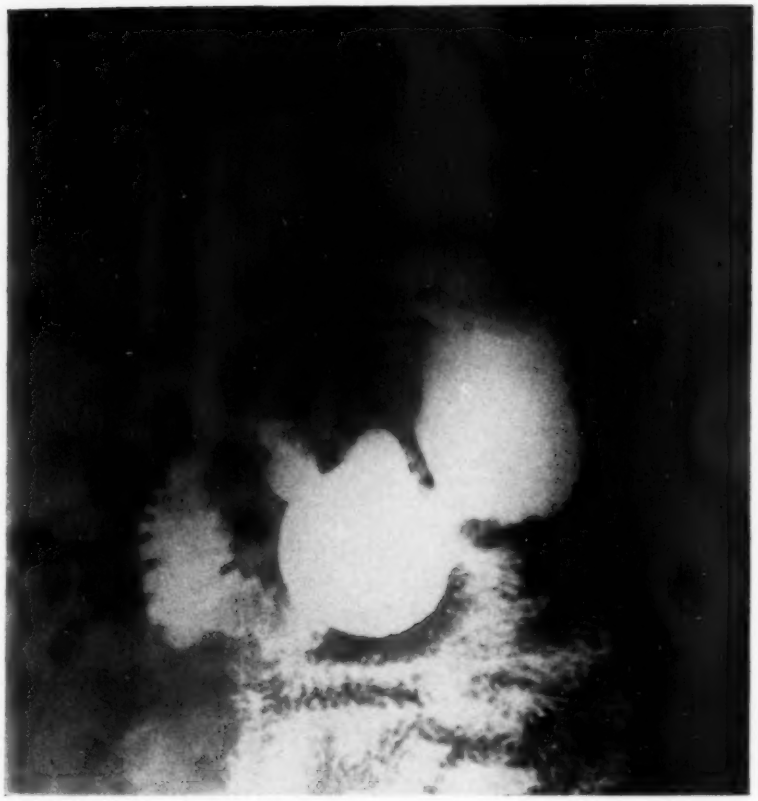

Fig. 3B. Same case as Fig. 3A.

Guthrie also reports that the lesion may be rapid in its formation and destructive in its characteristics. It may involve only the mucosa or may extend down through the entire thickness of the bowel wall, leading to perforation and hemorrhage. In Benner's series the acute necrotic lesion in the young patient was seen, as well as the lesion associated with inflammatory cellular reaction and repair in the older child. One of her patients (aged six) showed a definite healed ulcer in the bulb. None of the cases in this series have come to surgery or autopsy, so no statement can be made as to the type of process present.

From the observations reported in the literature, on surgical specimens as well as autopsy examinations, it is suggested that duodenal ulcer in the young is an acute necrotic and destructive process leading to hemorrhage and perforation, while in the older child, chronic inflammation associated with cellular infiltration may be present. That the development of fibrosis leading to stenosis is not uncommon is suggested by Bird's experience.

The question as to whether duodenal ulcer in children heals and stays healed, or whether there is a persistence of the ulcer or periodic recurrence from time to time, cannot be finally answered from the experience with this group of patients. Proctor's tracing of symptoms in adult ulcers back to childhood may be of great significance in evaluating the adult ulcer problem.

At the present time, 3 girls and 3 boys have been re-examined. One girl has had repeated attacks of symptoms following dietary breaks, and showed an active ulcer two years and three months after the first

Fig. 4. Five-year-old boy whose mother stated that he had been a feeding problem for many months. There was much complaint of anorexia, nausea, vomiting, and pain around the umbilicus. The duodenal bulb is small, spastic, and markedly deformed, with a persistent niche.

x-ray study. The second girl showed evidence of ulcer five months after the original examination, and in this case, also, there was poor adherence to the medical regime. The third girl was re-examined three and a half and eight months after the original examination and the bulb still showed evidence of irritability and ulcer. This patient has adhered well to the medical regime and, while fairly comfortable, still has attacks of mild abdominal pain.

One boy was re-examined at four weeks and again one year after the original examination. At four weeks, his symptoms had greatly improved, although the ulcer niche and irritability were still present. At one year, he still had symptoms and x-ray studies still showed evidence of irritability and niche. The second boy, re-examined after six months, had nausea but no abdominal pain or vomiting. Roentgen studies revealed an ulcer niche with persistent residual irritability. The third boy was re-examined at nine months and showed

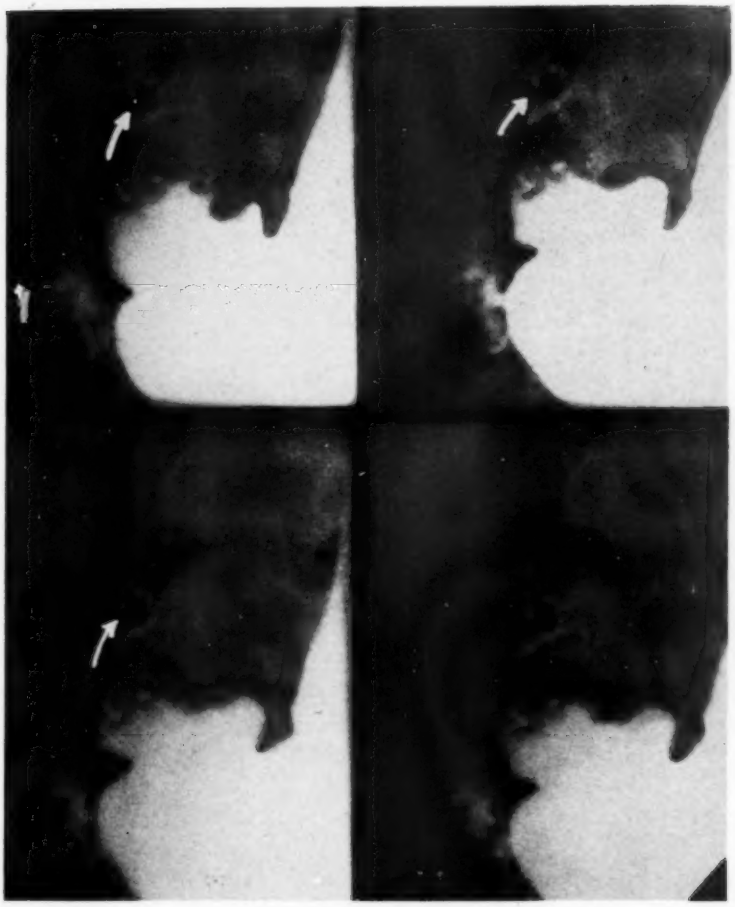

Fig. 5. Eleven-year-old girl with generalized abdominal pain, nausea, and vomiting of one year duration. Occasional blood in vomitus and in stool. The duodenal bulb is persistently deformed and non-retentive, with a typical niche defect at the apex. There is also a prominent mucosal pattern in the gastric antrum and an antral gastritis is probably present.

evidence of extensive bulbar deformity and irritability. Vomiting had diminished and gastric dilatation had decreased. Nausea and abdominal pain still occurred, frequently precipitated by very poor adherence to the dietary regime.

Follow-up histories have shown the remaining patients to be more or less well and without symptoms from their ulcers, although no further x-ray studies have been done. The others, as shown above, all have persistence of symptoms with x-ray evidence of active ulcer. These results suggest that some ulcers in childhood will heal under a conservative medical regime while some will persist. Whether this persistence will continue on into adult life cannot be stated at this time. The opportunity of further x-ray studies on this group in the future should prove interesting and may add some information to our knowledge of the adult ulcer symptom-complex.

DISCUSSION

The incidence of ulcer in children is questionable, and the number and sex of the patients in this series are of no signifi-

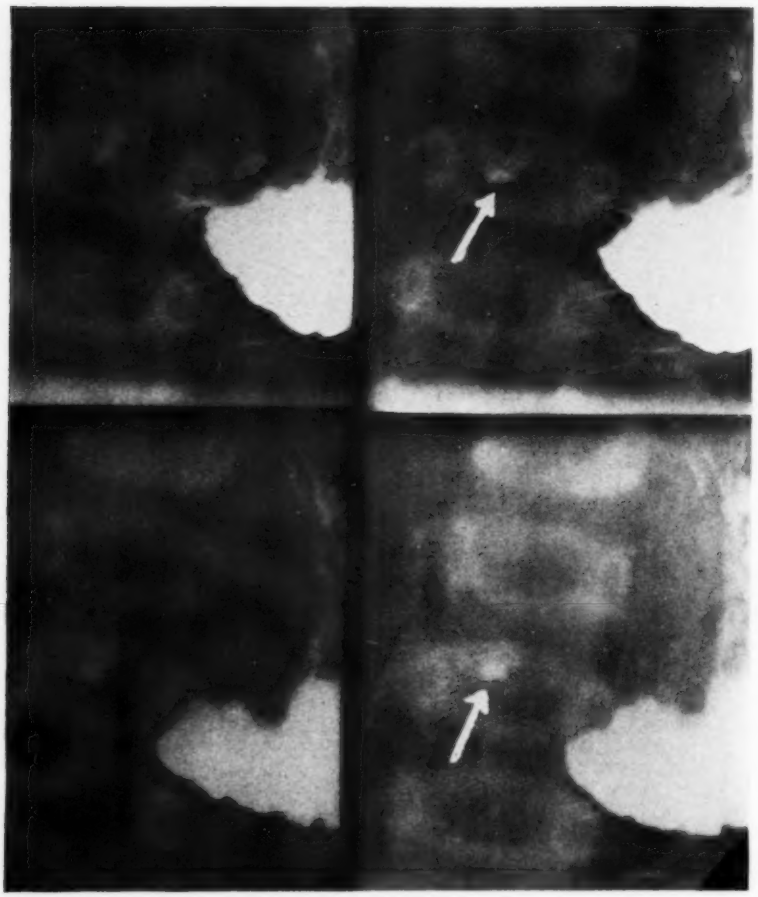

Fig. 6A. Five-year-old boy, with abdominal pain and vomiting of thick yellow mucus. There was much nausea and anorexia for all types of food. The duodenal bulb is markedly non-retentive and there is a persistent niche defect typical of ulcer.

cance statistically. The important point is the recognition that duodenal ulcer does occur and is probably more common than is generally believed. This does not imply that every child who presents symptoms of abdominal pain with vomiting has an ulcer, but the plea is made for a consideration of such a possiblity in evaluating gastrointestinal upsets and pain in children when these symptoms tend to recur with any degree of frequency. Perhaps most children present similar episodes at one time or another, lasting only a short time and then disappearing, and a careful history from the mother establishes the likelihood of a dietary indiscretion. Recurring attacks, should, however, receive more attention than a casual diagnosis of mesenteric adenitis, constipation, or perhaps food allergy or "low-grade appendicitis."

Some of the patients with x-ray evidence of duodenal ulcer will reveal to the careful questioner repeated attacks of intestinal upsets dating back for some months and may very well suggest the answer to the parent's statement that the child has been a feeding problem for an interval of greater or less duration.

Children with duodenal ulcer do not present the classical sequence of "pain, food, ease" which we have learned to associate with the disease in adults. The dividing

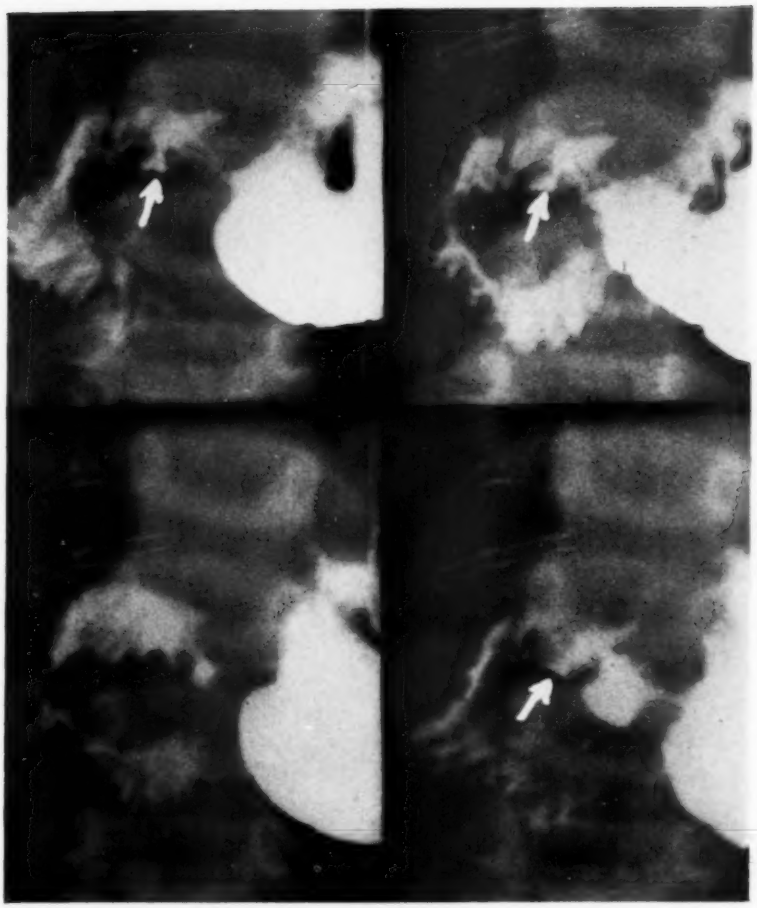

Fig. 6B. Same case as Fig. 6A, six months later. Symptoms were somewhat improved and there was no significant pain. Episodes of nausea still occurred, and dietary breaks usually resulted in vomiting. The bulbar defect is well shown and the cap is still irritable.

line in the symptoms produced depends apparently upon the character of the lesion rather than upon the age of the patient. Some of Bird's patients presented symptoms of ulcer complications, with bleeding, perforation, and obstruction, and in this group the symptom-complex was similar to that seen in adults. This would suggest that the uncomplicated ulcer usually seen in children is a shallow mucosal erosion which does not extend down beyond the mucosa, or perhaps the submucosa, and is apparently a process of not long duration. Inasmuch as the muscle and peritoneum are not involved in the process of mucosal necrosis and products of inflammation are usually lacking, the patients do not display symptoms of pain localized to the upper portion of the abdomen. The pain probably results from irritation of the ulceration mechanically by food, or perhaps chemically by gastric acid. Nausea and vomiting usually cause more concern to the patient than the abdominal pain. There is a tendency to frequent vomiting, and while some food is lost in this way, much loss of weight is infrequent. Some of the children are reluctant to eat because of the nausea, but there does not seem to be any relationship between the type of food or time of eating

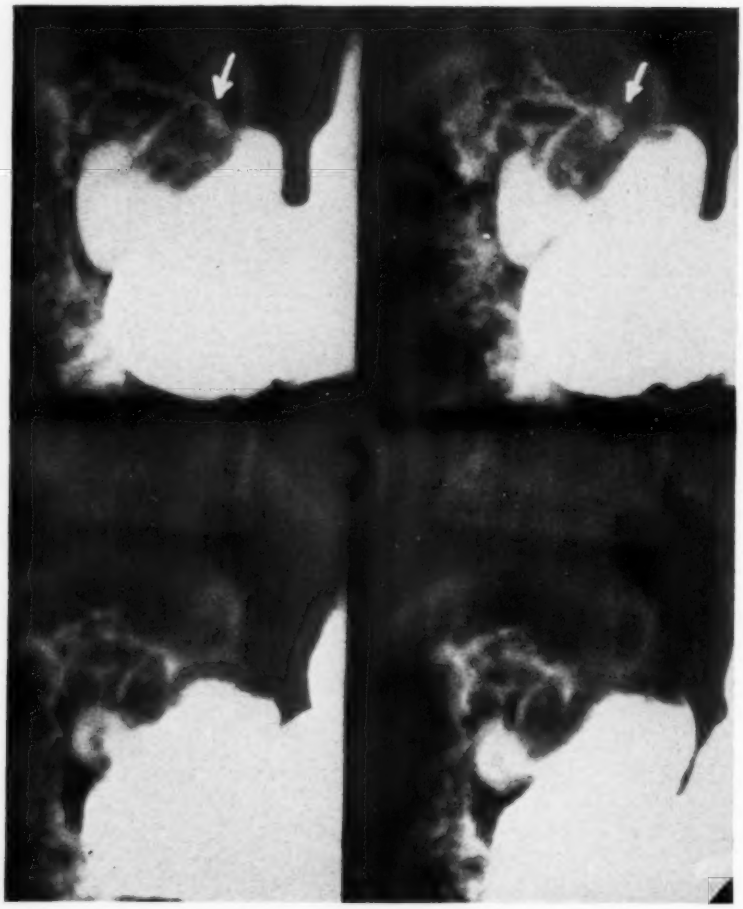

Fig. 7. Eleven-year-old boy who had complained of abdominal pain and nausea, but without vomiting, for many months. There was considerable spastic constipation, and eating was difficult because of nausea. Appendectomy eight months previous to x-ray examination did not relieve pain. The bulb is markedly deformed, with a prominent mucosal pattern and a persistent defect, suggesting an ulcer niche, at the base on the lesser curvature.

and relief of symptoms. The frequent pylorospasm seen in the screen examination would suggest a disturbance of the normal caudad distad intestinal gradient by a reflex irritability of the pylorus or perhaps direct irritability of the duodenum with resulting duodenal spasm. The duodenal irritability tends to the establishment of antiperistalsis and subsequent occurrence of nausea and vomiting.

It is essential that a niche defect be demonstrated to make the diagnosis of ulcer. Deformity of the bulb with or without irritability is not sufficient. Careful visualization of the pyloroduodenal region is required, and the ulcer niche will frequently be revealed in the right oblique anterior projection. Eccentricity of the pylorus so commonly associated with ulcer in the adult is usually not seen in children.

When the compression cone is used, the possibility of incarcerating a small amount of barium in a mucosal fold should be guarded against. This is a common error in thin children and is likely to produce a pseudo-ulcer defect. This possible diag-

nostic error can be corrected by repeated pressure and release of the cone during subsequent filming and repeated demonstration of the niche on the roentgenograms.

The x-ray diagnosis of ulcer in children should present no more difficulties than in the adult. If the diagnostic criteria are carefully appraised, autopsy material or surgical inspection to substantiate the diagnosis should not be necessary. Given a patient with a history of generalized or localized abdominal pain, with nausea and vomiting, in whom the symptoms are repeated, the possibility of ulcer should be considered and appropriate measures should be instituted to establish or exclude the diagnosis.

If the possibility of ulcer were considered and x-ray studies done more commonly upon this type of patient, it is very likely that a far greater number of lesions would be found and the generally accepted infrequency of the lesion would be disproved. Because a lesion is considered infrequent, one should not be deterred from the steps necessary to prove or disprove its presence.

There were numerous borderline findings on the films of many of the patients studied in this group, where an x-ray diagnosis of duodenitis or shallow superficial mucosal erosions was made. These cases presented symptoms which were about the same as in those patients showing a typical ulcer niche defect, suggesting that symptoms alone are not sufficient to establish the diagnosis of ulcer. Some of this group have been re-examined radiologically and on the second examination a niche has not been found, thus tending to corroborate the opinion that duodenitis as such is apparently not a precursor of duodenal ulcer.

CONCLUSIONS

1. Some significant facts regarding duodenal ulcer in children have been cited from the literature.

2. The disease is probably more common than is generally suspected.

3. Children who have recurring attacks of abdominal pain associated with nausea and vomiting should have an x-ray investigation of the stomach and duodenum to disprove the possibility of ulcer.

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(*Para el sumario en español, véase la página siguiente*)

SUMARIO

Ulcera Duodenal en la Infancia

La úlcera duodenal es más frecuente en la infancia que lo que se suele creer, de modo que hay que tener presente esa posibilidad en los niños que muestran episodios recurrentes de dolor abdominal asociado a náuseas y vómitos, debiendo verificarse el examen roentgenológico para confirmar o refutar el diagnóstico.

La comunicación actual se basa en 50 casos diagnosticados en el transcurso de 254 exámenes roentgenológicos en la práctica hospitalaria y particular. El enfermo más joven tenía dos y el mayor catorce años de edad.

Una úlcera duodenal activa en un niño suele traducirse por la presencia de un nicho ulceroso asociado, sobre todo en las primeras etapas del examen, a irritación del bulbo duodenal y piloroespasmo intermitente. El descubrimiento de un nicho es indispensable para el diagnóstico. Los casos de duodenitis, con erosiones poco profundas de la mucosa, pueden manifestar síntomas similares a los de la úlcera y hasta revelar deformidad del bulbo con o sin irritación.

Seis de los enfermitos del A. con síntomas persistentes fueron reexaminados a plazos más o menos largos, mostrando todavía signos roentgenológicos de úlcera en actividad. Los demás de la serie se hallaban en buena salud y asintomáticos. Esos resultados sugieren que algunas úlceras en los niños sanarán con un régimen médico conservador mientras que otras persistirán. No cabe declarar por ahora si esa persistencia continuará o no en la vida adulta.

Enlarged Gastric Rugae: A Correlation of the Roentgenologic, Gastroscopic, Pathologic, and Clinical Findings

Analysis of Forty-One Cases[1]

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THE CLINICAL and pathologic significance of enlarged gastric rugae as demonstrated by x-ray examination has been discussed in numerous publications since the original work of Forssell (1) and Cole (2), who demonstrated the importance of mucosal relief studies in the roentgen examination of the stomach. Much uncertainty and speculation has been eliminated since the introduction of gastroscopy.

Templeton (3) and Schindler have pointed out that a differential diagnosis between a benign and malignant gastric lesion cannot be made on the basis of enlarged mucosal folds. It seems worth while, however, to continue correlating our studies, and it may be that with more refined roentgenologic technic, directed especially toward the study of the movement of the gastric mucosa, the percentage of accurately diagnosed or suspected lesions will be improved.

During the interval from Jan. 1, 1940, through June 30, 1950, 32,640 x-ray examinations of the stomach were done in the Department of Radiology of Watts Hospital. This involved a total of 21,206 patients, the difference being due to repeated examinations. During this interval, 2,536 gastroscopic examinations were done on 2,340 patients. From this group, 41 cases were selected that showed chronic enlargement and tortuosity of the mucosal folds on repeated roentgen examination, associated with irregularity in contour, abnormal peristalsis, and hypersecretion. The roentgen changes in this group have been correlated with the clinical, gastroscopic, and, when these were available, the pathologic findings. Four cases are reported in detail and will be referred to in the text of this presentation. For comparison, two additional cases that presented some similar roentgen findings are included: Case V, a benign gastric ulcer with associated hypertrophic gastritis, and Case VI, a malignant lymphoma, probably a reticulum-cell sarcoma.

CLINICAL FINDINGS

Enlarged gastric rugae have been predominant in the male, there being 32 men and 9 women in our series. The age range was from twenty-four to sixty-four years at the time of the initial hospital admission. Twenty-five patients, or 61 per cent, were between the ages of twenty-five and forty-five. The average duration of symptoms was six and one-half years, the shortest period being six months and the longest twenty-five years.

Ulcer-like symptoms which were relieved by food were present in 14, or 34 per cent, of the patients. The remaining 27 patients enumerated their symptoms as nausea, often associated with vomiting, epigastric distress, and loss of appetite; food increased their discomfort (Cases I, II, III, and IV). A history of hemorrhage of varying degree was given by 12 patients, and of massive hemorrhage by one.

Fractional gastric analysis with the use of histamine as a stimulant was done on 38 of the 41 patients (Table I). Twelve showed complete absence of free hydrochloric acid on two or more examinations. Eight had hypoacidity and 10 hyperacidity. The degree of free hydrochloric acid did not appear to change the prognosis, as noted in the reported cases.

[1] From the Departments of Radiology and Pathology, Watts Hospital, Durham, N. C. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

TABLE I: FRACTIONAL GASTRIC ANALYSIS WITH HISTAMINE AS A STIMULANT

No. Cases	Total Acidity	Free HCl		Patients
		1st Specimen	Maximum	
12	36°	0°	0°	29.3%
8	56°	0°	32°	19.5%
10	102°	32°	94°	24.4%
8	70°	15°	49°	19.5%
3		Not done		7.3%
41				100.0%

ROENTGEN FINDINGS

The average width of the gastric rugae for two or more examinations during an interval of not less than one month was 8 mm. A 36-inch target-to-film distance was used in all examinations. The contour of both the greater and lesser curvatures of the stomach was usually ragged except where the mucosal folds had been completely obliterated, as demonstrated in Case I. Peristalsis was sluggish and ineffective. Motility of the gastric mucosa was limited, with either delayed or absent antral systole.

GASTROSCOPIC FINDINGS

All of the cases included in this series were studied by gastroscopy except Case I, which is reported in detail. The most constant finding was enlargement of the mucosal folds with some loss of flexibility. Nodulation of the folds producing a cobblestone appearance was not uncommon. The mucosa varied in color from a beefy red to a yellowish gray. Superficial ulceration with bleeding was present in 8 cases.

PATHOLOGY

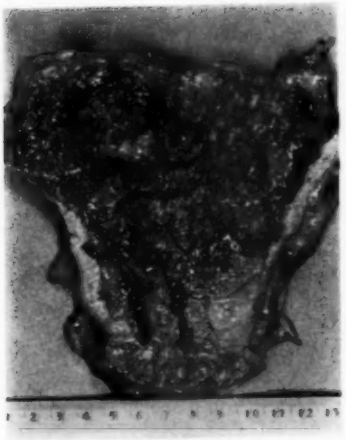
Material was available for pathologic study from 8 of the 41 patients, 4 of whom had a subtotal gastric resection and 4 removal of tissue for biopsy. Chronic gastritis, either hypertrophic or atrophic, was present in all cases studied.

In chronic gastritis of unknown etiology the mucosal folds may be of normal size, but usually they are either larger or smaller than normal. Consequently the terms "chronic hypertrophic gastritis" and "chronic atrophic gastritis" are in common use. In any form, edema, hemorrhage, and ulceration may or may not be apparent. In 3 of the cases reported here the roentgenologic and gastroscopic findings were equivocal, suggesting either a hypertrophic gastritis or neoplasm such as lymphoma; the pathologic findings were those of a hypertrophic gastritis in 2 and a reticulum-cell sarcoma in the other (Cases I, II, VI). In one patient hypertrophic gastritis became transformed into atrophic gastritis (Case I).

Except for the difference in the size and number of the glands, the microscopic features of chronic gastritis are fundamentally the same whether the mucosal folds are larger than normal or absent. The essential features consist of infiltration with inflammatory cells and alterations of the epithelial tissue.

The exudative reaction is difficult to evaluate because lymphocytes and plasma cells may normally be present in the gastric mucosa. The presence of an excessive number of lymphoid follicles, and the presence of inflammatory cells in the muscularis mucosae and in the submucosa, are believed to be significant. The cells of the exudate usually consist of lymphocytes and plasma cells, but neutrophils and eosinophils are also seen. Russell's bodies are often associated with plasma cells.

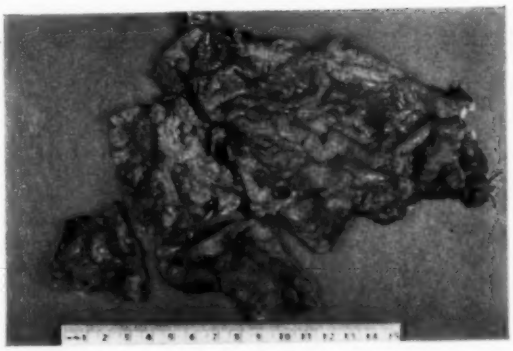
Changes in the gastric epithelium may or may not be found. The chief and parietal cells may be diminished in number and even completely replaced by cells showing excessive mucous secretion and resembling intestinal epithelium. Paneth cells may appear in some cases. The cells may become hyperchromatic and exhibit an excessive number of mitotic figures (4). Glands of atypical shape may be seen, as well as small cysts in the mucosa.



Case I

Case II

Case V



Case VI

Case I. The rugae are almost entirely absent and the mucosa is quite hemorrhagic, with numerous tiny ulcerations. Diagnosis: Atrophic gastritis.

Case II. The rugal folds, especially in the media, are quite prominent, but the mucosal surface is rather smooth except for a few areas that present a cobblestone appearance. Diagnosis: Chronic hypertrophic gastritis.

Case V. Chronic benign gastric ulcer. Thick, edematous rugae are present in the remainder of the specimen.

Case VI. Much of the gastric wall is infiltrated by a neoplasm, so that the rugae are almost obliterated. The mucosa is hemorrhagic and shows ulcerations of varying size. Diagnosis: Reticulum-cell sarcoma.

PROGNOSIS

The ultimate prognosis is not predictable. Three patients had a subtotal gastric resection for chronic indigestion that could not be controlled by a medical regimen. All have been relieved of symptoms. Cases I and III are reported in detail. In Case II a subtotal gastric resection was done for massive hemorrhages, with an uneventful recovery and no recurrence. In Case IV there was an acute perforation. The patient continues to have chronic indigestion, which probably will be relieved only by surgery.

Of the remaining 36 patients, 1 died six years after the initial examination, apparently of a coronary occlusion. Five are essentially symptom-free at the present time but still have some enlargement of the gastric rugae. Thirty continue to have chronic indigestion, which is in great measure controlled by a bland diet.

DISCUSSION

Analysis of 41 cases of chronic enlargement of the gastric rugae demonstrated histologic evidence of chronic gastritis in 8 and clinical symptoms suggestive of a similar process of varying degree in the remaining 33. Free hydrochloric acid was absent in 12 cases, but this apparently did not affect the prognosis, which is not predictable in a chronic gastritis. All of these patients have had recurrent episodes of chronic indigestion. Two other cases, a benign gastric ulcer with marked hyper-

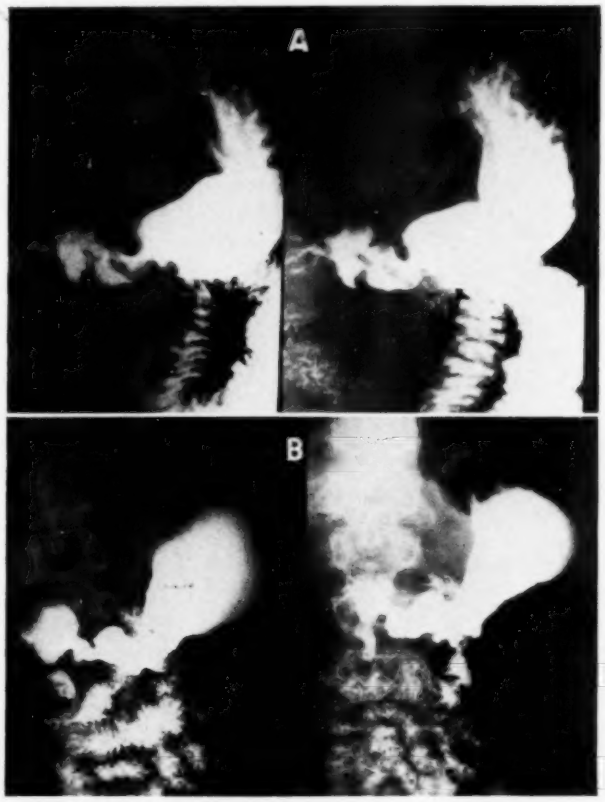


Fig. 1. Case I. A. Aug. 29, 1938. Enlargement of mucosal folds throughout, with poor antral systole. B. Jan. 16, 1950. Decrease in size of stomach with sluggish and ineffective peristalsis.

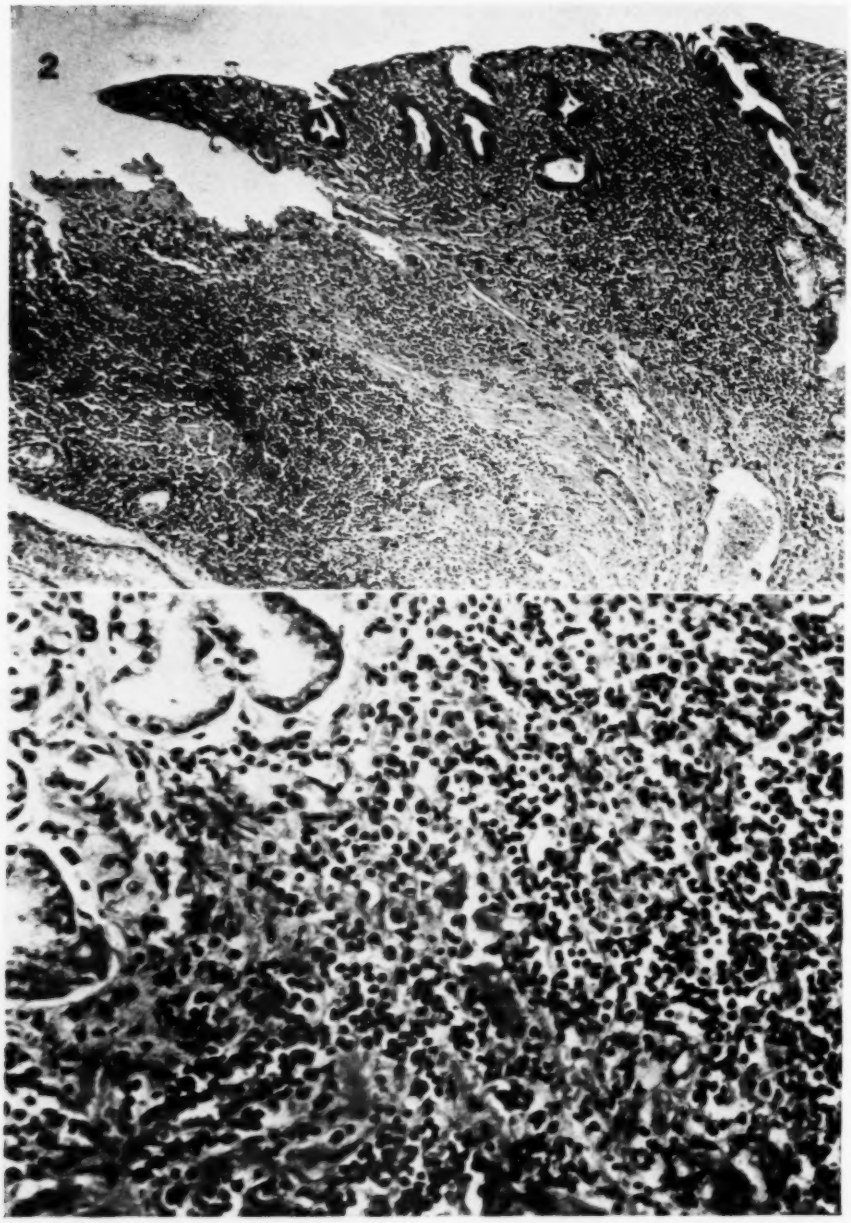


Fig. 2. Case I. Atrophy of the gastric glands, hyperchromatism of some of the lining epithelium, and marked chronic inflammation, ulceration, and fibrosis. Hematoxylin and eosin. × *c.*80.
Fig. 3. Case I. The mucosa and muscularis mucosae show extensive cellular infiltration. Hematoxylin and eosin. × *c.*350.

trophic gastritis, and a reticulum-cell sarcoma that presented similar roentgen findings, are included for comparison.

In our experience chronic enlargement of the gastric rugae is indicative of disease. Caution should be observed, however, in sus-

pecting a chronic process on a single roentgen examination, for an acute edematous gastritis may produce similar changes which will completely disappear within a few days (5).

The importance of careful roentgenologic study of the gastric mucosa, especially the motility, for detecting early changes that lead to a chronic process (6) cannot be over-emphasized. Fluoroscopy will be the ideal method for such study when technical factors have been developed so that the fluoroscopic detail is equal to or better than that of the present radiograph.

Gastroscopy is of inestimable value, not only as an aid in the differential diagnosis between benign and malignant lesions, but also in determining the extent of the disease and prognosis. It is unusual for a benign gastric ulcer to heal on a medical regimen when associated with such marked chronic gastritis as was demonstrated in Case V. The prognosis for recovery without surgery is equally poor in Cases I, II, III, and IV.

The differential diagnosis in chronic enlargement of gastric rugae associated with such roentgen changes as have been previously discussed is between a diffuse gastritis and a malignant neoplasm, as, for example, of the lymphoma group, which is demonstrated in Case VI. The accuracy in diagnosis should be markedly improved by the flexible operating gastroscope, through which a biopsy may be done (7). If, however, the x-ray, gastroscopic, and clinical findings are equivocal, surgical intervention should not be delayed.

SUMMARY AND CONCLUSIONS

1. Forty-one cases presenting marked chronic enlargement of the mucosal folds have been analyzed, with correlation of the roentgenologic, clinical, and gastroscopic findings.

2. The clinical symptom of chronic and recurring indigestion which was usually aggravated by food was present in 27 patients, while the remaining 14 had ulcer-like symptoms.

3. Fractional gastric analysis, with histamine as a stimulant, showed an absence of free hydrochloric acid in 12 cases.

4. Gastric resection was done for repeated massive hemorrhage in 1 patient and for chronic indigestion which was not relieved by a medical regimen in 3.

5. Pathologic studies were done on 8, and all showed a chronic gastritis.

6. The roentgen findings were characterized by chronic enlargement of the mucosal folds and irregular and sluggish peristalsis, with limited motility of the gastric mucosa.

7. Gastroscopy was helpful in the differential diagnosis, as well as in determining the extent of the disease and prognosis.

8. Chronic enlargement of the gastric rugae with the associated roentgen findings presented herewith is indicative of either a chronic gastritis or neoplastic infiltration.

CASE REPORTS

CASE I: S. C., white male, age 48, admitted Jan. 4, 1950.

Chief Complaints: Epigastric pain, nausea, vomiting, and loss of weight.

Family History: Irrelevant.

Past History: On Aug. 29, 1938, the patient had been admitted with a history of bloody vomitus and tarry stools of three days duration. At that time he stated he had had indigestion for the past six years, characterized by epigastric burning which was usually relieved by food. He was a chronic alcoholic and prior to this admission had consumed an average of 1 pint of whiskey daily for the past six months. The red blood cell count was 3,900,000; white cell count 10,500; hemoglobin 75 per cent. X-ray examination of the stomach showed considerable enlargement of the mucosal folds throughout. The antrum was spastic. There was some deformity of the duodenal cap at its base suggestive of a partial prolapse of the gastric mucosa into the duodenum (Fig. 1A).

The patient was seen in the outpatient department for three additional visits through July 18, 1943; however, no further x-ray studies of the gastro-intestinal tract were done until the present illness.

Present Illness: The patient stated that his indigestion began increasing in severity about one year previously, when he noticed that food would not relieve but increased his epigastric pain. During the past month he had been able to take only liquid nourishment and had lost about 30 pounds.

Physical Examination: Marked tenderness in the epigastrium; evidence of emaciation and dehydration.

Laboratory Studies: Red blood count 4,880,000;

white blood cells 9,700; hemoglobin 94 per cent. Fractional gastric analysis with histamine as a stimulant showed a maximum total acidity of 22°, free HCl 0°.

X-Ray Examinations: Examination showed the distal half of the stomach to be somewhat rigid, with irregular, sluggish, and ineffective peristalsis. No mucosal folds could be seen in any portion of the stomach. *Impression:* Gastric carcinoma (Fig. 1B).

Gastroscopic Findings: Unfortunately, the examining roentgenologist was so sure of the diagnosis that gastroscopy was not advised. Endoscopic study would have given much instructive information.

Clinical Course: On Jan. 24, 1950, a subtotal gastric resection was done. The surgeon described marked thickening of the stomach wall, with a crackling sensation on palpation, followed by bleeding into the gastric lumen. There were a number of enlarged lymph nodes on both the greater and lesser curvatures of the stomach. The lesion was sharply demarcated at the pyloric sphincter.

Pathologic Diagnosis: Severe chronic gastritis; chronic lymphadenitis.

Gross Description: The specimen consisted of a portion of stomach including the pylorus. Unopened it measured about 13 cm. in length and 7 cm. in width. Omental tissue was attached to both curvatures and this contained several pea-sized lymph nodes. On opening the stomach, no rugae were present except for a few which were quite low. The entire mucosa was hemorrhagic and there were a number of small areas of superficial ulceration (see color plate).

Microscopic Description: The specimen showed an extreme degree of chronic gastritis. The mucosa was thinner than normal and the glands were atrophic. The remaining glands had distorted shapes and many of them did not reach to the muscularis mucosae. The glandular epithelium showed atypical features, including hyperchromatism and excessive mucous secretion. The cells of the exudate consisted almost entirely of lymphocytes and plasma cells. The exudate was abundant in the mucosa and was also present in the muscularis mucosae, the submucosa, and in some parts of the muscularis. The mucosa showed a number of small areas of ulceration and there was an occasional fibrous scar suggesting that small ulcers had healed (Figs. 2 and 3).

Comment: This interesting case was followed for approximately twelve years and progressed from an acute hypertrophic to an extensive atrophic gastritis. The general appearance on roentgen examination was most suggestive of an infiltrating carcinoma.

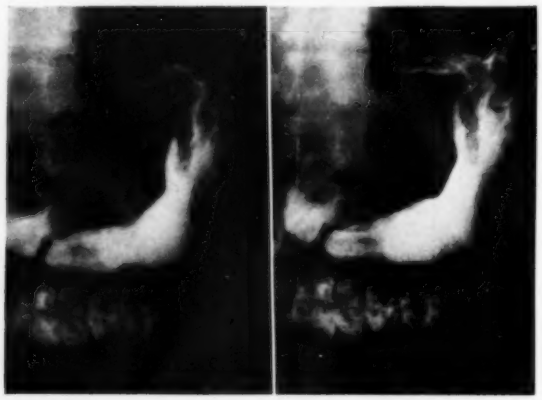


Fig. 4. Case II. Aug. 15, 1944. Marked enlargement of mucosal folds with irregular greater curvature and sluggish peristalsis.

CASE II: T. O., white male, age 52, first admitted May 23, 1944.

Chief Complaint: Progressive development of weakness during past three months, associated with hunger pains, nausea, and vomiting.

Family History: Irrelevant.

Past History: Gaseous indigestion and hunger pains suggestive of an ulcer had been present for fifteen to twenty years, but prior to the present illness the symptoms had usually been relieved by food and alkalis.

Physical Examination: The patient appeared to be about his stated age, but was very anemic and acutely ill. There was no tenderness or rigidity over the abdomen. The rectum was full of tarry stool.

Laboratory Studies: Red blood cells 1,420,000; hemoglobin 24 per cent; white blood cells 13,000.

X-Ray Examinations: Twenty-four days after

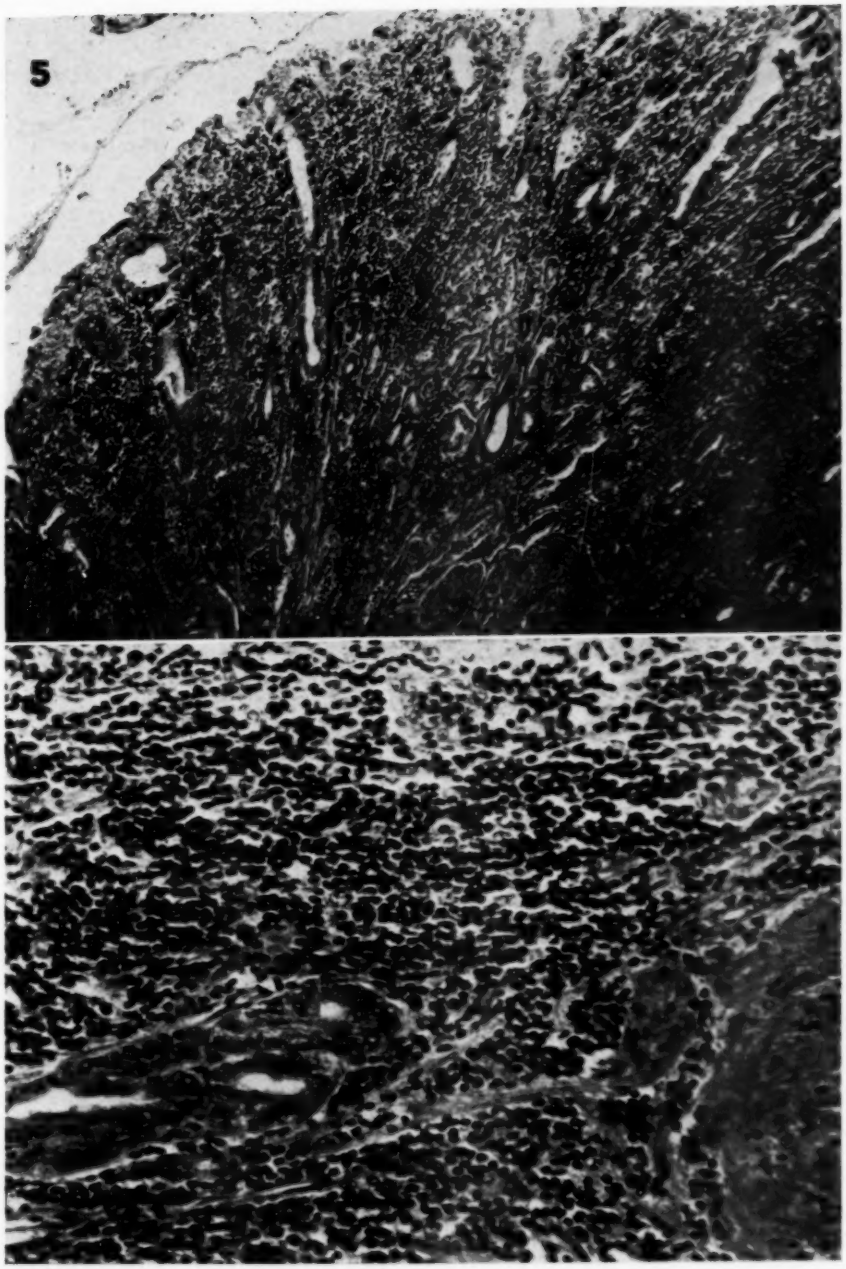


Fig. 5. Case II. Photomicrograph showing the tip of one of the enlarged rugae with extensive lymphocytic infiltration in the mucosa. Hematoxylin and eosin. × *c*.80.

Fig. 6. Case II. Heavy lymphocytic infiltration in the lower part of the mucosa, extending into the hypertrophied muscularis mucosae. Hematoxylin and eosin. × *c*.350.

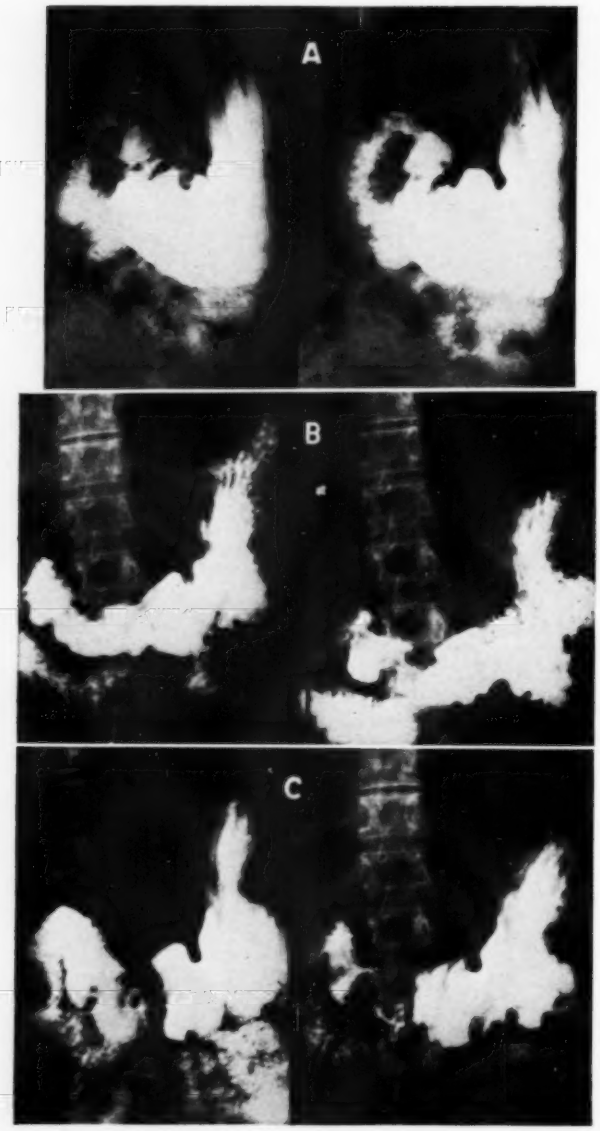


Fig. 7. Case III. A. Jan 8, 1949. B. May 5, 1950. C. July 5, 1950. Progressive enlargement of mucosal folds with hypersecretion and irregular peristalsis.

admission, the stomach showed marked enlargement of the mucosal folds throughout, with some irregularity on the greater curvature at the junction of the fundus and media. This region could not be palpated satisfactorily during fluoroscopic examination, but it appeared somewhat rigid. Peristalsis was irregular, sluggish, and ineffective. No ulceration was seen. *Impression:* 1. Malignant neoplasm, such as lymphoma. 2. Diffuse hypertrophic gastritis (Fig. 4).

Gastroscopic Findings: The mucosal folds throughout thes tomach were enlarged, reddened, and edematous and showed only a moderate decrease in size on inflation. The stomach appeared pliable throughout except for an area on the greater curvature at the junction of the fundus and media which appeared

to be infiltrated. A few superficial areas of ulceration, 1 to 3 mm. in diameter, were present. No hemorrhage was noted. *Impression:* Probably diffuse hypertrophic gastritis; lymphoma could not be excluded. Repeat examinations by x-ray and gastroscopy in three to five weeks were advised, for comparison.

Clinical Course: Repeated blood transfusions and symptomatic treatment were given, with fairly good response. The gastro-intestinal bleeding, nausea, and vomiting had stopped on the fourth hospital day. On the sixth hospital day bronchopneumonia developed, but the patient recovered without complication.

Follow-Up Studies: The patient was discharged July 2, 1944 (forty days after admission), in good condition; hemoglobin 90 per cent. He returned four weeks later with a recurrence of gastro-intestinal bleeding which started about six days earlier. Hemoglobin was now 52 per cent. After the hemorrhage was controlled, the x-ray and gastroscopic examinations were repeated, with essentially the same findings. A partial gastrectomy was done Aug. 24, 1944.

Pathologic Diagnosis: Chronic hypertrophic gastritis.

Gross Description: The specimen consisted of a segment of stomach including the pylorus. It had been opened along the greater curvature and measured 16 × 11 cm. There was no ulceration or fixation of the mucosa at any place. The rugae were much thicker and more prominent than usually seen. Some of the mucosal surface presented a cobblestone appearance (see color plate).

Microscopic Description: The gastric mucosa appeared thicker than normal but the glands showed no particular alterations. An exudate consisting largely of plasma cells infiltrated practically all of the superficial half of the mucosa. In some places exudate was present in the deeper part of the mucosa and also involved the muscularis mucosae. The submucosa and muscularis appeared essentially normal (Figs. 5 and 6).

Comment: This case demonstrates the degree of massive hemorrhage that may occur in chronic hypertrophic gastritis. The condition of this patient is still excellent, with only minimal indigestion and no recurrence of the gastric hemorrhage since the operation slightly over six years ago.

CASE III: F. B., white female, age 49, admitted May 24, 1950.

Chief Complaint: Cramp-like epigastric pain for past six weeks.

Family History: Irrelevant.

Past History: The patient was treated for a urinary tract infection in 1937, at which time she first experienced some indigestion characterized by epigastric discomfort and gas. This was relieved by food, especially milk. Mild episodes of this nature occurred during the interval until the present illness, with increasing severity and frequency during the past year.

Fig. 8. Case III. The rugal folds are hypertrophied and the surface has a cobblestone appearance.

Present Illness: The patient dated the onset of her present illness at about six weeks before admission, when she experienced crampy epigastric pain associated with some nausea. This was in part relieved by food and alkalis but continued to get worse. There had been a weight loss of 9 pounds during this interval.

Physical Examination: Moderate tenderness in the epigastrium, otherwise negative.

Laboratory Studies: Red blood cell count 4,900,000; white blood count 6,700; hemoglobin 98 per cent. Gastric analysis, with histamine as a stimulant: amount 200 c.c.; total acidity 85° and free HCl 70°.

X-Ray Examinations: On May 25, x-ray examination of the stomach showed marked enlargement of the mucosal folds throughout, but more prominent in the media, where both the lesser and the greater curvature presented a somewhat ragged appearance. Peristaltic waves passed over the stomach rather slowly and somewhat ineffectively. The stomach was pliable, but the mucosal folds could not be obliterated. The examination was repeated June 5 and August 29, with no appreciable change (Fig. 7 A, B, and C).

Gastroscopic Findings: (May 27 and Aug. 30). The mucosal folds throughout the stomach were enlarged, but more marked in the media, where there was nodulation in some areas and atrophy of the mucosa in others. The appearance was that of combined hypertrophic and atrophic gastritis.

Clinical Course: The patient was placed on a strict medical regimen for peptic ulcer, including Banthine, but with no clinical evidence of improvement. On Sept. 26, 1950, a partial gastrectomy was done.

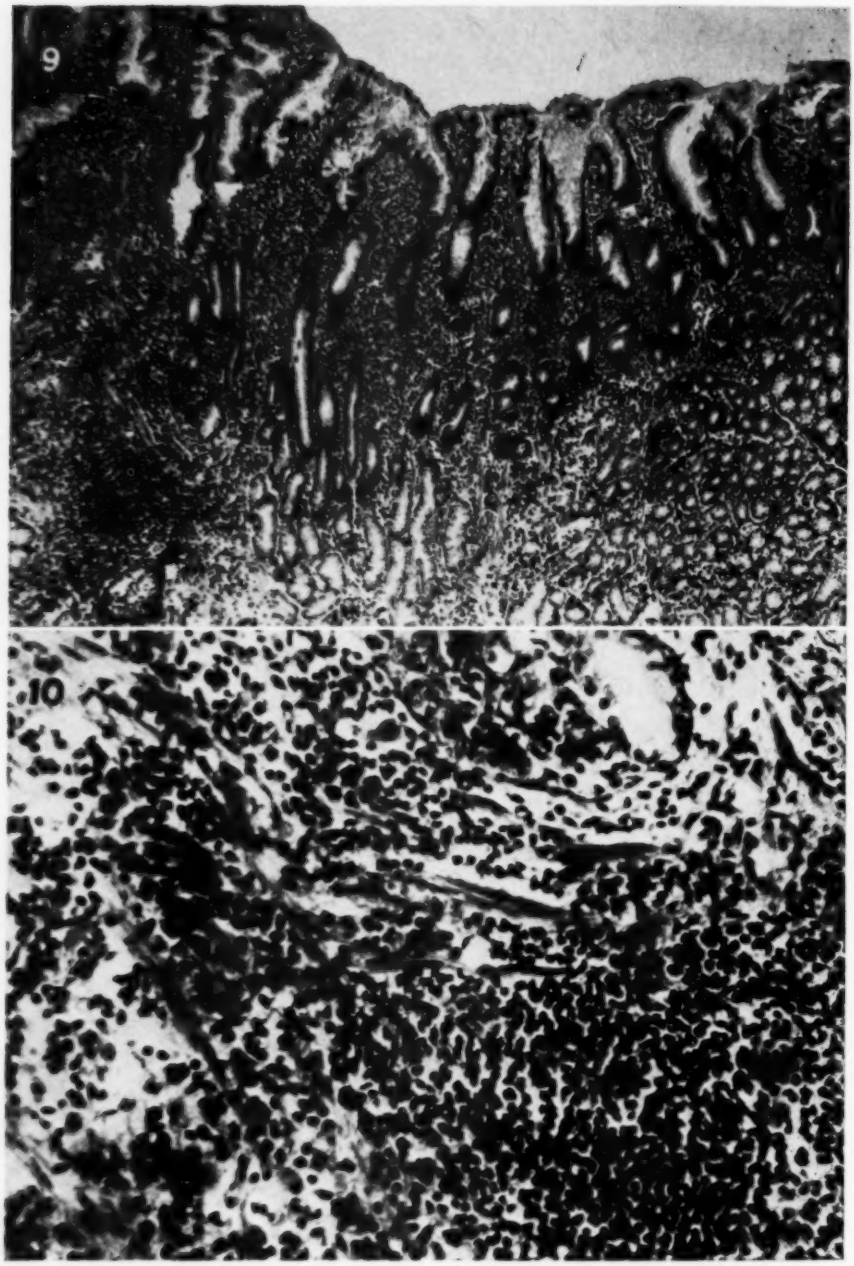


Fig. 9. Case III. Photomicrograph showing infiltration of the mucosa and submucosa with chronic inflammatory cells. Hematoxylin and eosin. × *c.*80.

Fig. 10. Case III. Photomicrograph showing infiltration of the muscularis mucosae and submucosae with lymphocytes and plasma cells. Hematoxylin and eosin. × *c.*350.

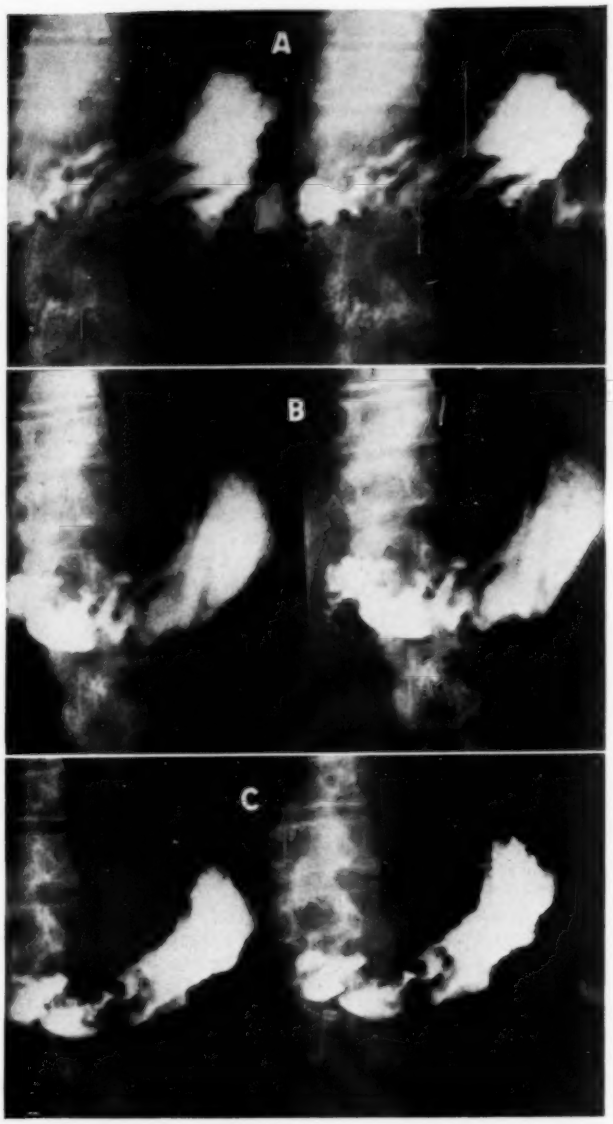


Fig. 11. Case IV. A. Aug. 17, 1942. B. May 18, 1946. C. Nov. 3, 1950. Enlarged mucosal folds; ragged greater and lesser curvatures; poor antral systole. Perforation April 8, 1948.

The surgeon described rather marked thickening of the stomach especially in the media.

Pathologic Diagnosis: Chronic hypertrophic gastritis.

Gross Description: The specimen consisted of a portion of stomach including the pylorus. It measured 13 cm. along the lesser curvature and 22 cm. along the greater curvature. The thickness varied between 0.5 and 1.5 cm. There was marked hypertrophy of the rugal folds, particularly in the media. Most of the mucosal surface had a cobblestone appearance. There was no ulceration, but a number of small hemorrhagic spots were seen in the mucosa (Fig. 8).

Microscopic Description: A chronic inflammatory reaction involved the mucosa and in some places extended into the muscularis mucosae and the superficial part of the submucosa. The cells of the exu-

date consisted largely of lymphocytes, plasma cells, eosinophils, and neutrophils. An occasional Russell's body was seen. In places the gastric glands were widely separated by the exudate. The mucosa appeared thicker than normal, with deep pits in some places. No ulceration of the surface was seen. The muscularis was thick and fibrosed and contained scattered inflammatory cells (Figs. 9 and 10).

Comment: This patient gave a history of chronic indigestion for thirteen years that became progressively worse during the two years before a subtotal gastric resection. The symptoms have been completely relieved.

CASE IV: D. W., white male, age 51, first admitted Aug. 16, 1942.

Chief Complaints: Chronic indigestion, loss of appetite, and gradual loss of weight during past year.

Family History: Irrelevant.

Past History: In April 1937, the patient experienced rather severe indigestion, characterized by epigastric pain, heartburn, and gaseous distention, occurring three to five hours after meals. This discomfort was usually relieved by food or alkalis. The indigestion gradually disappeared after four months; The patient continued, however, to drink milk between meals and at bedtime. There had been no definite recurrence until the present illness.

Present Illness: Approximately fourteen months before the present admission, the indigestion recurred with somewhat different symptoms, being characterized by chronic epigastric discomfort, loss of appetite, and nausea, with a gradual loss of fifteen pounds in weight. The discomfort had been progressive and was not relieved by food or alkalis.

Physical Examination: Negative except for epigastric tenderness and evidence of weight loss.

Laboratory Studies: Gastric analysis, with histamine as a stimulant, showed the maximum total acidity 92°, free HCl 63°. The blood count and other studies were within normal limits.

X-Ray Examinations: The stomach showed marked thickening of the mucosal folds in the media and antrum and some irregularity on the greater curvature. Peristalsis was irregular and somewhat ineffective. Antral systole was prolonged. No ulceration was noted. *Impression:* Probably hypertrophic gastritis (Fig. 11A).

Gastroscopic Findings: On Aug. 22 gastroscopy revealed marked thickening of the mucosal folds throughout the media and proximal portion of the antrum, with some nodulation. The stomach was pliable, although peristalsis was very sluggish. A few superficial areas of ulceration were noted just proximal to the angulus. *Impression:* Probably hypertrophic gastritis. Lymphoma could not be excluded.

Clinical Course: A strict medical regimen was instituted for one month, with marked symptomatic improvement. The x-ray and gastroscopic studies were repeated and showed only slight change. Gastric resection was refused by the patient because of the symptomatic improvement. He returned at intervals of six to twelve months, through November of 1946, for follow-up x-ray and gastroscopic studies, which showed only slight improvement (Fig. 11B). Indigestion had recurred, as well as gradual weight loss.

On April 8, 1948, at 2:00 A.M., the patient was admitted in shock. Examination of the abdomen revealed marked rigidity and tenderness in the epigastrium. An x-ray film of the chest showed free air beneath both sides of the diaphragm, indicating perforation of a hollow viscus.

The operating surgeon found a pin-point perforation of the stomach on the anterior wall near the greater curvature in the distal portion of the media. The stomach was described as being thickened throughout, especially in the media, but no definite infiltration could be found. Due to the poor condition of the patient, the perforation was sutured and the abdomen closed as quickly as possible. A biopsy was not done.

Recovery was uneventful, and follow-up films, Nov. 3, 1950, showed no improvement (Fig. 11C).

Comment: This patient has had frequent follow-up studies for eight years with no appreciable change in the appearance of the stomach and little change in clinical symptoms. This case was complicated by an acute perforation. A subtotal gastric resection should be done, but the patient continues to refuse.

CASE V: J. B. W., white male, age 30, was first admitted on Dec. 4, 1940.

Chief Complaints: Pain in stomach, weakness, and shortness of breath.

Family History: Irrelevant.

Past History: Irrelevant except as associated with present illness.

Present Illness: The patient had had attacks of epigastric discomfort during the past five years characterized by a pressure sensation associated with pain of a deep boring type. These attacks lasted three to four days and could usually be relieved by a mild diet. The symptoms increased in severity up to the time of admission. Four weeks before admission he had tarry stools, followed by weakness and shortness of breath.

Physical Examination: Negative except for tenderness in the epigastrium and evidence of anemia.

Laboratory Findings: Red blood count 2,510,000; hemoglobin 45 per cent; white blood count 8,000. Fractional gastric analysis, with histamine as a stimulant, showed a maximum total acidity of 48° and free HCL 13°.

X-Ray Examinations: The stomach showed a

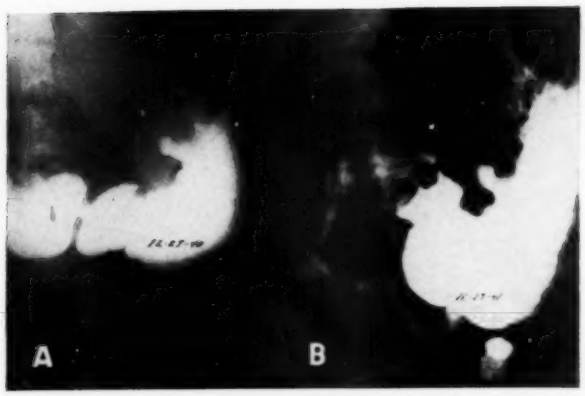


Fig. 12. Case V. A. Dec. 27, 1940. B. Nov. 13, 1941. Large gastric ulcer on lesser curvature, with no change in size; mucosal folds thickened; peristalsis almost absent.

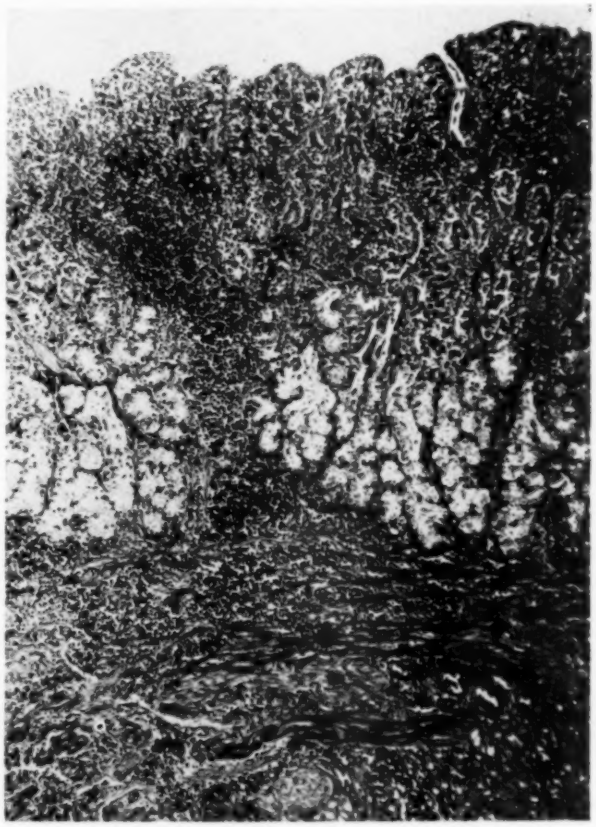


Fig. 13. Case V. The muscularis mucosae is hypertrophied and infiltrated with lymphocytes and plasma cells. Hematoxylin and eosin. × *c*.80.

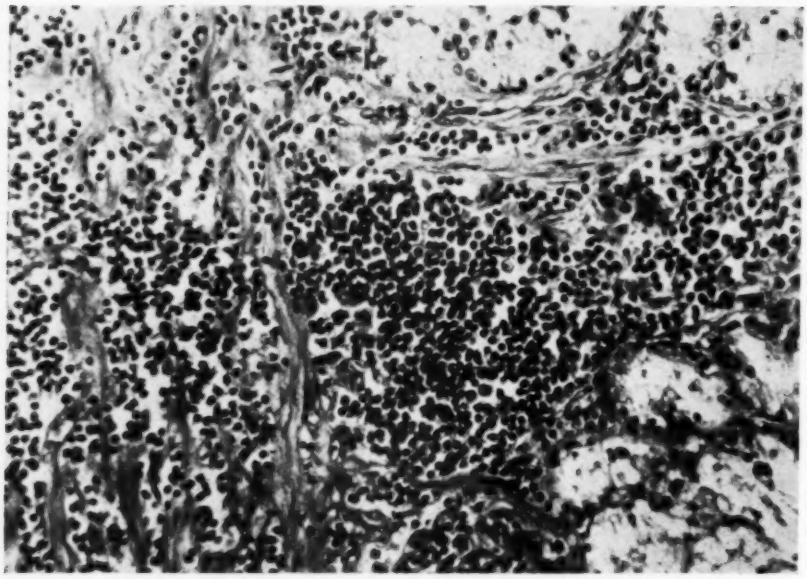


Fig. 14. Case V. In addition to chronic inflammation, the photomicrograph shows excessive mucus secretion in the gastric epithelium. Hematoxylin and eosin. × *c.*75.

large penetrating ulcer on the lesser curvature, in the distal portion of the media, measuring 3 × 3.5 cm. in diameter. The mucosal folds throughout the stomach were markedly enlarged and the stomach wall was somewhat rigid. Peristalsis was sluggish (Fig 12A).

Gastroscopic Findings: Endoscopic examination (J. M. R.) showed a sharply demarcated ulcer, 2 × 3 cm., on the posterior wall near the lesser curvature in the distal portion of the media. The mucosal folds throughout the greater portion of the media were enlarged, red, and nodular. *Impression:* Benign gastric ulcer with marked hypertrophic gastritis.

Clinical Course: A strict medical regimen in the hospital for four weeks led to some clinical improvement. Repeat x-ray and gastroscopic studies showed no apparent change. The patient refused to submit to a partial gastrectomy and was discharged slightly improved. On Dec. 2, 1941, he was readmitted with a recurrence of the original symptoms and gastro-intestinal bleeding. X-ray examination showed no appreciable change in the stomach (Fig. 12B). A partial gastrectomy was done on Dec. 4.

Pathologic Diagnosis: Chronic peptic ulcer of stomach. Chronic hypertrophic gastritis.

Gross Description: The specimen consisted of the pyloric portion of the stomach, measuring 16 cm. along the greater curvature and 8 cm. along the lesser curvature. It was 12 cm. wide at the proximal line of excision and 3 cm. at the distal. The serosa was covered with hemorrhagic adhesions, most extensive along the lesser curvature. There was a peptic ulcer astride the lesser curvature measuring 2 cm. across. This ulcer had perforated all layers of the gastric wall, including the serosa. The surrounding muscularis was fibrosed. The remaining gastric mucosa was in thick edematous folds, and the surface was covered with mucus (see color plate).

Microscopic Description: The tissue bordering on the peptic ulcer showed fibrosis, granulation tissue, infiltration with neutrophils, eosinophils, and lymphocytes, and necrosis of the surface. Elsewhere the gastric mucosa was moderately infiltrated with inflammatory cells, chiefly lymphocytes. The muscularis mucosae was thickened and showed rather extensive lymphocytic infiltration. Similar infiltration was seen in the superficial part of the submucosa. There were a number of lymphoid follicles with reaction centers in the mucosa and also the submucosa (Figs. 13 and 14).

Comment: This patient had very marked chronic hypertrophic gastritis associated with a benign ulcer. It is unusual for such combined pathologic processes to improve on a medical regimen. The patient has been essentially symptom-free for nine years.

CASE VI: L. T., white female, age 68, was first admitted on Dec. 5, 1947.

Chief Complaint: Epigastric pain following meals during past six months.

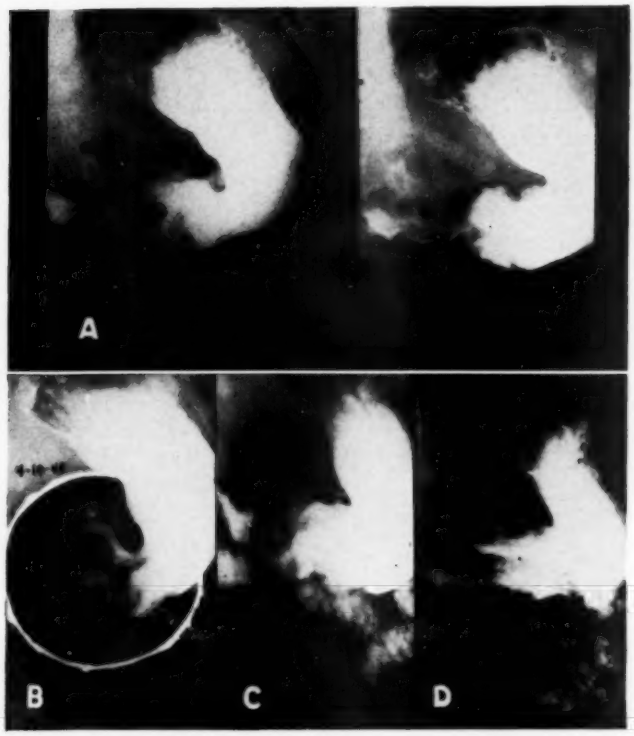


Fig. 15. Case VI. A. Dec. 11, 1947. B. April 10, 1948. C. July 7, 1948. D. Jan. 28, 1949. Prepyloric filling defect, with progressive enlargement of mucosal folds.

Family History: One brother died with cancer of the stomach.

Past History: Had been a "cardiac" patient for past ten years with episodes of decompensation.

Present Illness: About six months before admission the patient developed what she described as a "peculiar indigestion." It was characterized by an epigastric bloating with a burning and boring pain. She was frequently awakened about 2:00 A.M. by the pain. Food and alkalis usually relieved the discomfort.

Physical Examination: There was marked evidence of cardiac decompensation. No abdominal masses were palpated.

X-Ray and Gastroscopic Examinations: Enlargement of the mucosal folds in the antrum was seen roentgenologically, with a questionable filling defect (Fig. 15A). Due to cardiac decompensation and a state of general debility, gastroscopy and surgery were not considered feasible. The patient made a partial recovery and returned on April 29, 1948, for repeat x-ray examination of the stomach, which showed an increase in the size of the mucosal folds in the antrum with a definite filling defect (Fig. 15B). Gastroscopy now showed marked enlargement of the mucosal folds in the distal portion of the media and antrum. The antral region could not be dilated, and there appeared to be a submucosal infiltration; however, there was no evidence of ulceration. *Impression:* Lymphosarcoma or possibly a diffuse hypertrophic gastritis. Due to the poor condition of the patient, the consulting surgeon advised observation and further medical treatment.

On July 7, 1948, follow-up x-ray studies of the stomach showed a progression of the lesion (Fig. 15C); however, the patient was essentially free of gastric symptoms and refused surgical treatment. Laboratory studies were negative except for an absence of free HCl.

Clinical Course: On March 2, 1949, the patient was readmitted, having consented to a surgical exploration. She was somewhat dehydrated, with profound nausea and vomiting and a loss of 60 pounds in the past four months. On March 7, a partial gastrectomy was done. A postoperative course of x-ray therapy was given and the general condition at present is satisfactory, with no evidence of recurrence.

Pathologic Diagnosis: Malignant lymphoma, probably reticulum-cell sarcoma.

Gross Description: The specimen consisted of three pieces of tissue from the stomach. When

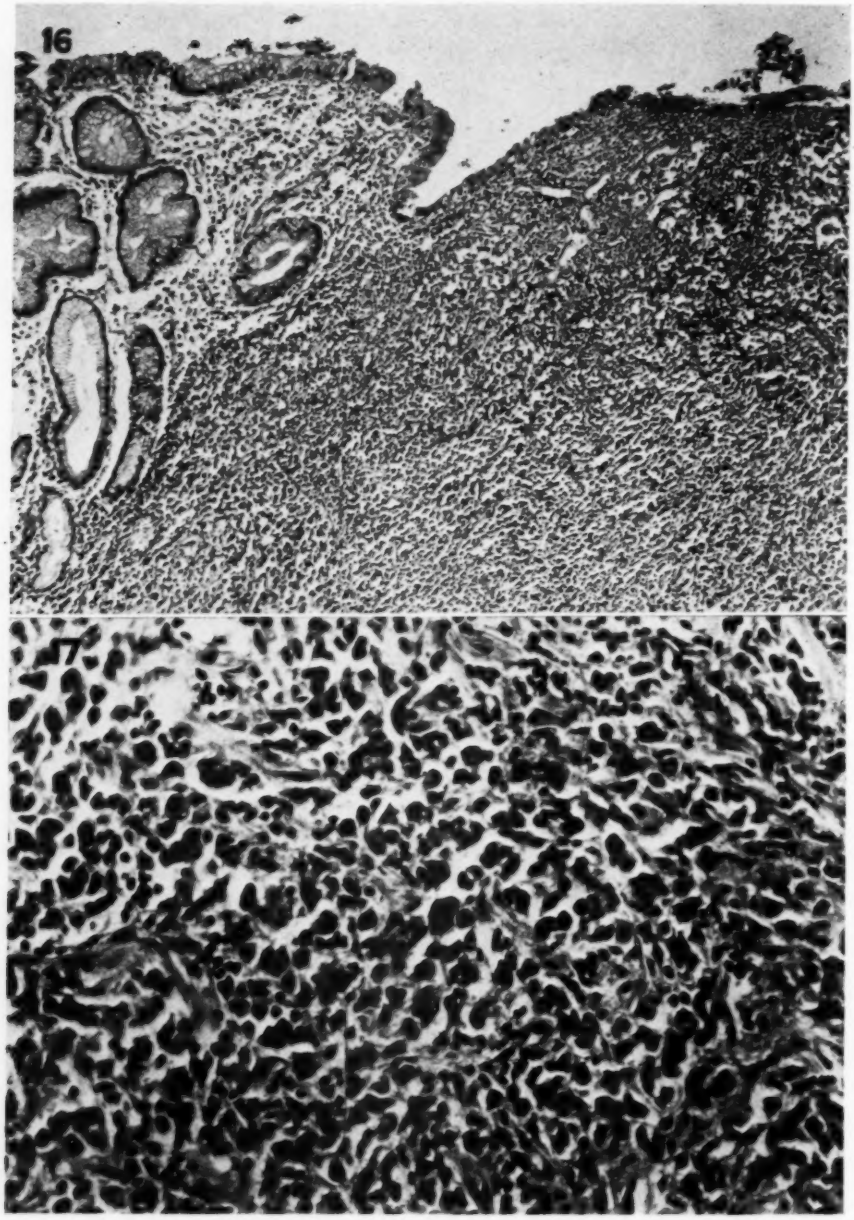


Fig. 16. Case VI. Edge of the malignant lesion infiltrating the stomach. The surface of the tumor is ulcerated. Hematoxylin and eosin. × *c*.80.

Fig. 17. Case VI. Photomicrograph showing pleomorphic character of the tumor cells. Some mitotic figures are visible. Hematoxylin and eosin. × *c*.350.

opened and placed together they measured 18 × 13 cm. The thickness varied between 1.0 and 2.0 cm. The mucosa was hemorrhagic and showed several irregular areas of ulceration. In some parts of the specimen, rather large, broad rugal folds were seen. On section, the entire thickness of the mucosa and submucosa had a homogeneous appearance, with a gray, moist, opaque surface. In places of greatest

involvement the muscularis was replaced by this type of tissue. In the omental tissue several lymph nodes measuring up to 1 cm. in diameter were found, which also had a gray, moist, opaque cut surface (see color plate).

Microscopic Description: In addition to chronic gastritis with hypertrophy and cellular infiltration of the mucosa, this specimen showed a malignant tumor. The tumor was anaplastic, being composed of pleomorphic cells with hyperchromatic nuclei of variable size, exhibiting frequent mitotic figures. This tumor was believed to be a malignant lymphoma, probably reticulum-cell sarcoma. In places it invaded all layers of the gastric wall and was present in the adjacent lymph nodes (Figs. 16 and 17).

Comment: The roentgen findings are similar to those noted in Case I on the initial examination; however, the process progressed more rapidly. The differential diagnosis between neoplasms of this type and a chronic hypertrophic gastritis is frequently very difficult.

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SUMARIO

Hipertrofia de las Arrugas Gástricas: Correlación de los Hallazgos Roentgenológicos, Gastroscópicos, Patológicos y Clínicos. Análisis de Cuarenta y Un Casos

Este análisis de 41 casos en que repetidos exámenes roentgenológicos del estómago revelaron hipertrofia y tortuosidad crónicas de los pliegues de la mucosa, asociadas a irregularidad del contorno, peristaltismo anormal e hipersecreción trata de correlacionar las alteraciones roentgenológicas con los hallazgos clínicos, gastroscópicos y, en los casos en que los había a mano, anatomopatológicos.

En todos los casos existían síntomas clínicos de indigestión crónica y recurrente que el alimento solía agravar. Antecedentes de hemorragia más o menos intensa fueron mencionados por 12 enfermos. El más constante hallazgo gastroscópico consistió en hipertrofia de los repliegues de la mucosa, con alguna pérdida de flexibilidad. En 8 casos ejecutáronse estudios anatomopatológicos, existiendo gastritis crónica en todos.

No cabe exagerar la importancia que reviste el cuidadoso estudio roentgenológico de la mucosa gástrica, y en particular de la movilidad de la misma, para el descubrimiento de alteraciones incipientes que pueden conducir a un proceso crónico. La gastroscopia también posee valor inestimable tanto para ayudar a diferenciar entre lesiones benignas y malignas cuanto para determinar la extensión de la enfermedad y el pronóstico de la misma.

Preséntanse con todo pormenor 4 casos típicos. Agréganse a ellos un caso de úlcera gástrica benigna unida a gastritis hipertrófica y un caso de sarcoma reticulocelular.

DISCUSSION

George W. Chamberlin, M.D. (West Reading, Penna.): Contrary to my usual disposition, I find little to criticize in these two excellent papers, so I will mostly emphasize what the authors have said.

First, the paper by Dr. Alexander. You probably have noticed that in the recent radiological literature there have been quite a few papers on peptic ulcer in children. This presentation of Dr. Alexander seems, therefore, to be timely and important. I think that such a paper could well be published in the journal or journals read by general practitioners, pediatricians, internists, and others, since these men, rather than the radiologist, need to be alerted to the many unrecognized cases of peptic ulcer occurring in childhood.

Dr. Alexander is to be complimented on his high incidence of positive findings for duodenal ulcer—11.8 per cent of 254 children under the age of fifteen. I assumed, when I read his paper, that this meant that these children were carefully screened and selected on a clinical basis before the roentgen examination was made. I would like to ask Dr. Alexander if he has any other explanation for so high an incidence. I would also like to know how many gastric ulcers were seen in this small group of 254 children.

The essayist has pointed out that it seems advisable to divide ulcer-bearing children into three clinical groups: Those up to the age of two, whose ulcers may be associated with an intracranial lesion and who usually give a rather grave prognosis; the children from two to six, whose chief symptoms are those of gastro-intestinal hemorrhage; and then the third group, from seven to fifteen years of age, who have a clinical picture more or less approaching that of ulcer as seen in the adult.

I again emphasize the importance of this paper, particularly to impress our colleagues in the various fields of internal medicine that children with abdominal pain may have something other than cramps or mesenteric adenitis.

Dr. Vaughan's paper on enlarged rugae seems to be a very excellent presentation. I think Dr. Vaughan has bravely and effectively entered a controversial field of roentgen diagnosis in chronic gastritis. From his findings, it appears that the words "atrophic" and "hypertrophic" should be used cautiously if at all by radiologists, since one condition may become the other or the microscopic inflammatory changes may be essentially the same whether the gastric rugae appear larger or smaller than normal.

As I review his paper, the main point seems to be to call to our attention a group of patients having a clinical picture of ulcer hemorrhage or indigestion; gastroscopic demonstration of enlarged rugae with or without irregularity; and roentgen findings of persistent enlarged gastric rugae, irregular gastric folds, diminished peristalsis, decreased mobility of the gastric rugae.

Dr. Vaughan and his associates showed convincing pathological evidence of chronic gastritis in 8 of a series of 41 patients. In the remainder of the group, 33 patients, there was clinical evidence suggestive of chronic gastritis. I am not sure that one should draw any conclusions beyond this. Maybe Dr. Vaughan will disagree with me in that respect and, if so, I should like to hear his comments. Every one of us present appreciates the difficulty of making a roentgen diagnosis of chronic gastritis. The diameter of the gastric folds is not a reliable criterion, since an appearance of enlarged folds may be produced by certain drugs, by hyperactivity of the thyroid, allergy, and technical factors employed in the examination.

Dr. Vaughan has wisely eliminated some of these factors by repeated examinations. It is well known that enlarged rugal folds may be seen roentgenologically in the presence of thin mucosa and that a normal rugal pattern may be seen when the stomach is actually the site of a chronic gastritis. I think that those of us who use the term "mucosal folds" should perhaps do so advisedly and in most instances speak rather of gastric rugae, since pathological changes which are seen on roentgen examination may be due not only to the mucosa but also to changes in the submucosa.

As I looked at the last one or two slides which Dr. Vaughan presented I was reminded somewhat of the analogy of trying to diagnose carcinoma of the breast in a patient who has cystic mastitis. I think it is extremely difficult and I believe that, as radiologists, we may be treading on rather thin ice if we try to diagnose carcinoma of the stomach in patients who have a chronic gastritis. It is an extremely difficult differential diagnosis.

The importance of this paper is therefore in emphasizing the need of careful correlation of clinical, gastroscopic, and roentgenological findings before making the definite diagnosis of chronic gastritis.

I want to commend the author on his excellent presentation.

Ross Golden, M.D. (New York): Dr. Chamberlin mentioned allergy as one possible cause of large mucosal folds in the stomach. I have seen one case in which very large folds became normal

and the patient's symptoms disappeared shortly after milk was eliminated from the diet. This is unusual, but is worth bearing in mind.

Two or three of Dr. Vaughan's films showed evidence of herniation of the prepyloric mucosa through the pylorus into the duodenum. This herniation is responsible for symptoms in some cases and is attracting considerable attention at the present time. It can be taken as evidence of gastritis. The first paper describing this phenomenon was published in 1926 by our honored chairman, Dr. Pendergrass (Eliason, E. L., Pendergrass, E. P., and Wright, V. W. M.: Roentgen-ray Diagnosis of Pedunculated Growths and Gastric Mucosa Prolapsing through Pylorus, Am. J. Roentgenol. **15:** 295, April 1926). This publication was an important contribution to radiology of the stomach.

Dr. Vaughan and Dr. Chamberlin both commented upon the difficulty in differential diagnosis of gastritis from carcinoma. Whenever we think of carcinoma of the stomach, we should think of it in terms of its gross growth characteristics, that is, the manner in which the cells grow in the wall. The linitis plastica type gives us the most trouble because it grows underneath the mucous membrane, enlarges and stiffens the folds without mucosal destruction in the early stages, and acts much like an inflammatory process. The carcinoma cells wiggle their way through the tunica muscularis to the serosa apparently very early in the course of the disease, without destroying the muscle and without impairing the ability of the stomach to contract, until the condition becomes far advanced. In the early stages it seems to be practically impossible to detect this type of growth, at least for me.

Dr. Vaughan's material is exceptional because he does the gastroscopy as well as the radiology and his contributions are always important. This symposium has been very much worth while.

Dr. Alexander (*closing*): As the men from Philadelphia know, my hospital is in the suburbs in a very actively growing section of West Philadelphia. My first case was that of a doctor's son. We had been discussing an adult ulcer patient of the doctor's, and he said: "Every time my boy gets ready to get on the school bus in the morning, he complains he doesn't feel well, has a pain in his stomach, is nauseated, and vomits. Do you suppose he could have a duodenal ulcer?"

I knew nothing about ulcer in children except what I had read, so I said: "Let's find out." X-ray studies of the boy's stomach were done, and I saw and reported what I believed to be a duodenal ulcer. Because it was uncommon in my experience, I gave a case report on it at the next staff meeting. Following that, I had a lot of cases. Apparently a lot of the men on the staff had patients with repeated abdominal pain and vomiting that they were worried about and hadn't been able to control very well, and I seemed to get a lot of children in a very short time with symptoms similar to those of the doctor's son.

I now find that the number of these patients that I am examining is tapering off. I am not seeing as many as I did at first because I think I probably got the majority within a short time.

I should like to emphasize the fact that our institution is just a general hospital, not a pediatric hospital, although we do have a growing community, so that the people are primarily younger married folk who are raising families. That is the only explanation I have for the high incidence, or at least the seemingly high incidence, of ulcer I have reported.

Walter W. Vaughan, M.D. (*closing*): In answer to the question that was raised by Dr. Chamberlin, I had no intention of leaving the impression that one can always make a diagnosis of gastritis on roentgen examination. I did say that perhaps some time in the future, when fluoroscopic detail is equal to or better than that of the present radiograph, and we can study the movement of the mucosa as has been emphasized by Dr. Golden, we might possibly progress just a bit further in the x-ray diagnosis of such superficial changes as are often found in gastritis.

In regard to allergic enlargement of gastric rugae, I presented in a previous publication a case with a filling defect which simulated a carcinoma of the stomach. The point that I wish to emphasize is that chronic enlargement of the mucosal folds with changes in peristalsis, hypersecretion, and some rigidity, as demonstrated in these cases and discussed in detail in my text, always means the presence of disease.

Secondary Radiation Fields Surrounding Photofluorographic Equipment[1]

WILLARD W. VAN ALLEN, B.Sc.[2]

THE PROTECTION of x-ray personnel from excessive radiation has for some time been recognized as a problem of major importance. In photofluorographic work, this problem assumes even greater importance, since the radiation hazards associated with the operation of photofluorographic equipment are considerably greater than those encountered in large-film roentgenography. In the first place, the quantity of radiation required for a photofluorographic exposure is several times that needed for a conventional roentgenogram. Moreover, in photofluorographic work, as many as five hundred or more exposures may be made in the course of a day, a number far in excess of that accomplished in most large-film operations. In addition, most photofluorographic equipment is portable, semiportable, or installed in the limited space provided by a mobile bus, so that protective devices cannot always be designed and placed as effectively as in permanent installations.

Despite these seeming handicaps, adequate protection against excessive exposure to radiation can be achieved. This may be accomplished in two ways: first, by employing protective barriers so designed and located as to reduce radiation to a minimum; second, by limiting the number of exposures made by a team of operators in any one day, depending upon the intensity of radiation to which they are subject in a given installation. In either case, a thorough knowledge of the radiation fields surrounding photofluorographic installations is required, so that protective barriers may be designed and placed properly, and so that safe limits of exposure, in terms of numbers of exposures, may be determined.

In 1946 Morgan and Lewis (1) reported measurements of scattered radiation fields in the vicinity of the then-standard 35-mm. photofluorograph. The study included isodose curves in the unprotected regions around a photofluorograph set up in a relatively large open room, as well as notes on the relative effect of other conditions, such as confining walls and the use of 70 mm. and other film sizes. Although these results are still entirely valid for the conditions under which they were obtained, the almost universal adoption of 70 mm. equipment since the completion of that study, as well as the development of improved screens and other equipment which shorten exposures, make necessary a reexamination of radiation fields. Furthermore, no radiation measurements in the so-called protected areas behind screens has until now been available.

The present study was therefore undertaken to determine the field patterns of scattered radiation surrounding photofluorographic equipment now in use. A wide variety of installations was studied, utilizing both portable and mobile equipment in many different locations. In addition, attention was directed to radiation in unprotected regions as well as that encountered behind protective screens.

Radiation was measured by means of an integrating ionization chamber circuit, shown schematically in Figure 1. This particular type of equipment was chosen in order to obviate the necessity of making exposures of long duration, as would be required in order to obtain readings on instruments of the non-integrating type. The time constant of non-integrating instruments, which read dosage rates rather than total dose, is seldom less than two seconds, and even then accurate readings are impossible. Furthermore, it is difficult or impossible to adjust present-day photo-

[1] Accepted for publication in October 1950.

[2] Physicist, Division of Tuberculosis, Public Health Service, Federal Security Agency, Washington, D. C.

fluorographic equipment to milliamperage values low enough to permit prolonged exposures without damage to the x-ray tube or tedious delays between exposures. By the use of an integrating circuit sufficiently sensitive to record the total amount of scattered radiation per exposure, direct measurements could be made at any point during an exposure of normal milliamperage, kilovoltage, and time. Moreover, these readings could be made either in the course of routine examinations with human subjects or with the use of a substitute phantom.

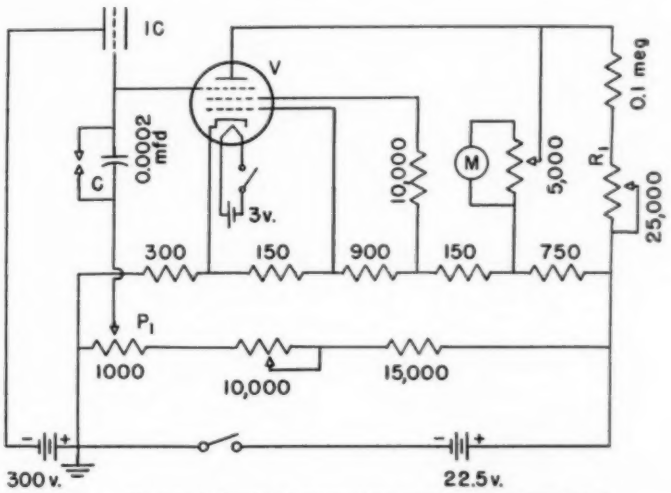

Fig. 1. Electrical circuit of integrating roentgen exposure meter.
The circuit consists essentially of a low-leakage condenser (C), ionization chamber (IC), electrometer tube (V), and meter (M). Operation is as follows: With the calibrated bias potentiometer (P_1) at zero (ground end), the instrument is brought to null-balance position by means of the rheostat (R_1). Ionizing radiation falling on the chamber causes a current to flow through it, charging the condenser (C) to a voltage proportionate to the amount of radiation received. This voltage, applied to the grid of the electrometer tube, unbalances the circuit as indicated by the meter (M). A restoring voltage is then applied by rotating the calibrated potentiometer (P_1) until the condition of balance is again obtained. This restoring voltage, read from the dial of the potentiometer, is then a measure of the amount of radiation which fell on the chamber during the exposure. After reading, the potentiometer is returned to zero, the condenser is discharged by means of a push button, and the circuit is ready for the next measurement. The instrument is calibrated by means of a Victoreen condenser r meter, using radiation of the same quality as that scattered from a 12.5-cm. presdwood phantom.

For measurements of scattered radiation outside the protected areas, the ionization chamber used in the illustrated circuit was a standard Victoreen chamber of approximately 100 c.c. capacity. With this chamber and its associated circuit constants, the range of measurable radiation was from 0.2 to 3.0 milliroentgens.

For measurement of the very much lower radiation encountered behind protective barriers, a specially constructed ionization chamber of about 800 c.c. capacity was used (Fig. 2). This was capable of giving readings from 0.01 to 0.20 milliroentgen. For convenience, it was connected to the control cabinet by means of a flexible cable rather than as shown in the figure. This chamber is unconventional in that, instead of a solid wall, a cylinder of copper window screen was used. This gives an essentially transparent wall which is well suited for radiation measurements of very low intensity. Although it is true that the use of this type of wall might introduce measurement errors, these have been practically elimi-

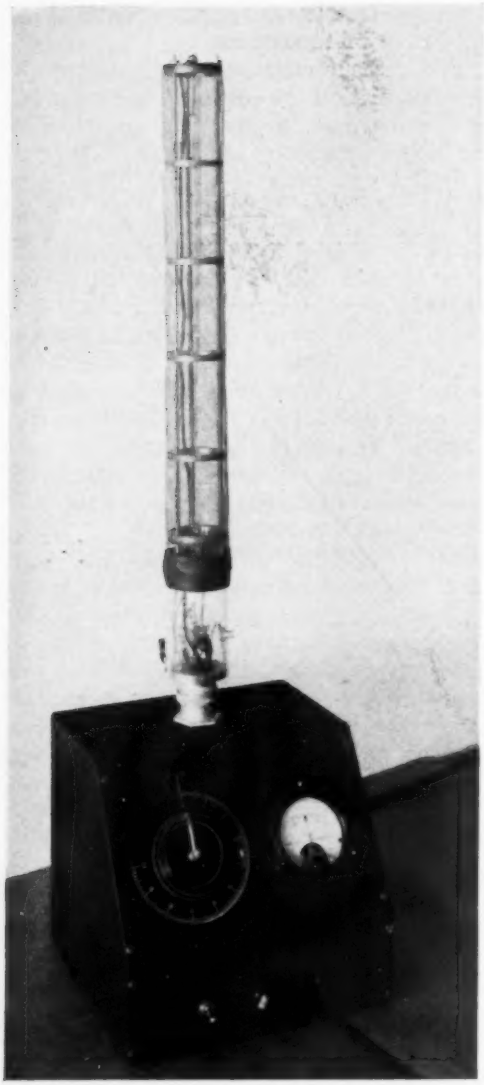

Fig. 2. Special 800-c.c. ionization chamber used for measuring roentgen exposures of low intensity (0.01 to 0.20 milliroentgen).

nated by calibrating the instrument with radiation of the same quality as that which it was designed to measure.

The radiation fields surrounding typical photofluorographic installations were mapped by taking a suitable number of readings at regular intervals throughout the areas involved. These readings were made on U. S. Public Health Service installations during regularly scheduled operations of a mass survey program. No attempt was made to adjust the equipment for optimum conditions, so that measurements are representative of conditions actually encountered during routine photofluorographic operations. In those installations where the number of human subjects was sufficient, the subjects themselves were used as the source of scattered radiation. Where the number of human subjects was small, a phantom of tempered presdwood measuring 40 cm. square by 12.5 cm. thick was substituted.[3] Several ionization chamber readings were taken at each of many points, and average radiation per exposure was computed for each point. In this manner, radiation field maps were obtained for a wide variety of installations, ranging from the very large, unconfined space of a railroad station concourse to the limited area within mobile bus installations.

The results of these measurements are shown diagrammatically in Figures 3 to 5, where the quantities of radiation present at various points are indicated by isodose curves labeled to show roentgens per 100 exposures. Figures 3 and 4 show the radiation fields surrounding two typical portable installations: the first, made at the train concourse of the North Station in Boston, represents conditions where walls and ceilings are extremely remote; the second was made in a smaller room. Field patterns plotted in numerous other portable installations showed so little significant variation that these two examples will suffice. Figure 5 shows the radiation fields surrounding photofluorographic installations in four types of mobile units with different floor plans.

In general, field patterns in the regions outside the protective barriers are very similar in all types of installations, whether they be in open rooms or within closely

[3] Such a phantom was shown by Morgan and Lewis (1) to be equivalent in scattering characteristics to a 24-cm. human chest. This was again demonstrated in the course of this investigation, where readings taken with the phantom correlated closely with the average of those taken with human subjects at the same point.

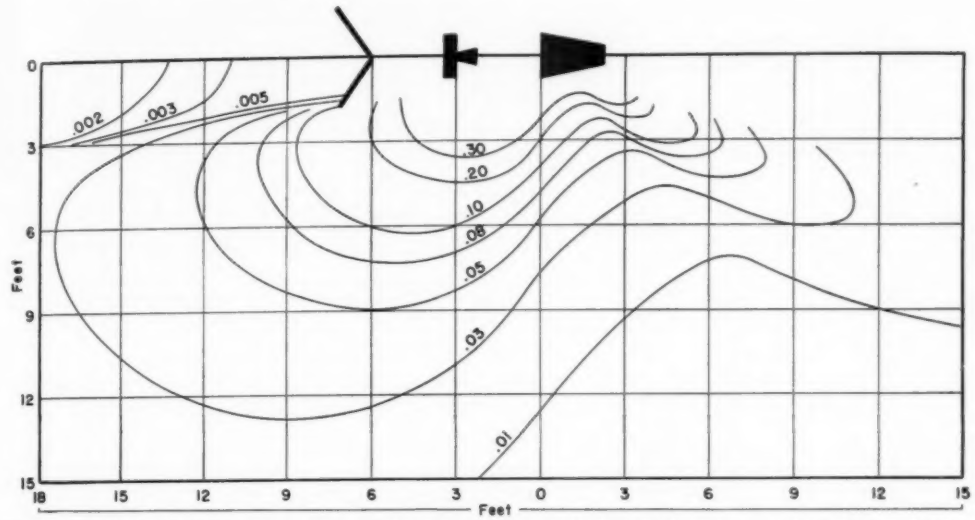

Fig. 3. Field of radiation surrounding a typical photofluorographic installation in a very large room. Isodose curves labeled to indicate radiation in roentgens per 100 average exposures.

confining walls. Even when walls are quite close, as in the mobile units, their effects are apparent only in a slight intensification of the radiation, rather than any appreciable alteration of the general contour of the isodose curves.

There is one region, however, in which the field patterns vary widely from one installation to another. Roughly, this region lies along a line running from the x-ray tube past the edge of the fluoroscopic screen. In one particular installation (Fig. 3), for example, there was a very pronounced bulge in the isodose curves in this region, roughly in line with the primary beam. In some installations, this peculiarity is apparent on both sides of the hood; in others, it appears on one side, but not on the other, while in still others there is no such bulge at all. Undoubtedly, the intensity of radiation in this particular region depends upon the efficiency of coning of the primary beam and upon the accuracy with which the beam and the center of the fluoroscopic screen are aligned.

For obvious reasons, radiation intensities encountered behind protective barriers and in other protected areas are of the greatest interest. In portable installations the protective device usually employed

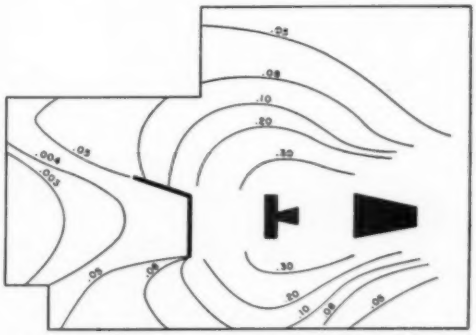

Fig. 4. Field of radiation surrounding a typical photofluorographic installation in a small room. Isodose curves labeled to indicate radiation in roentgens per 100 average exposures.

consists of a V-shaped screen, hinged in the middle and placed behind the x-ray tube. Technicians and clerks are positioned behind this screen, in the region of its "radiation shadow." Figure 6 shows typical radiation patterns behind two such screens in the area of the "shadow." Measurements directly behind and not more than a few inches from the screen indicate a lower level of radiation intensity than that encountered several feet behind the screen. It would appear, therefore, that most of the radiation behind the screen comes around it, rather than through

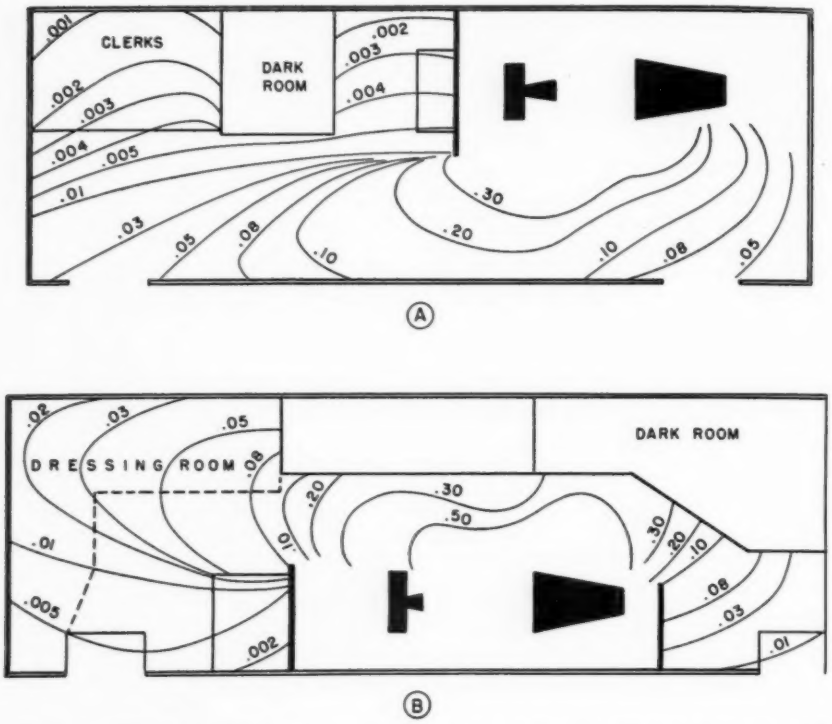

Fig. 5, A and B. Fields of radiation surrounding typical photofluorographic installations in mobile bus units of different floor plan. Isodose curves labeled to indicate radiations in roentgens per 100 average exposures. See also Fig. 5, C and D.

it. In a small room, the proximity of the ceiling and walls could perhaps account for this. It is also present, however, in large rooms, which suggests that its source must be the floor, ceiling, or the surrounding air itself. In some types of protective screens, moreover, the hinge between the two sections offers a small but definite area of almost no protection, at the very location most likely to be occupied by the operator (Fig. 6).

In the case of photofluorographic equipment installed in bus units, on the other hand, the radiation patterns behind the protective barriers are entirely different, varying widely in character with different floor plans (Fig. 5). In three of the four types of mobile bus units illustrated, measurements of field intensity were made on at least two units of similar type. Among units of the same type, no significant differences in radiation patterns were noted. In the fourth type illustrated (Fig. 5D), which was unique, it was difficult to draw isodose curves in the regions behind the screens, and only the values of radiation intensity measured at several isolated points are indicated.

From the patterns of radiation field contours behind the protective screens of mobile units, some interesting observations can be made. In Figure 5A, for instance, the isodose curves in the space occupied by the technician indicate that the field represented could only have been produced, for the most part, by radiation entering laterally, that is, from a direction perpendicular to the general direction of the isodose lines. If the radiation had entered this space through the screen, either wholly or in part, a very different pattern, at least in orientation, would have obtained. This suggests that the radiation emanated from the bus walls opposite the area in question.

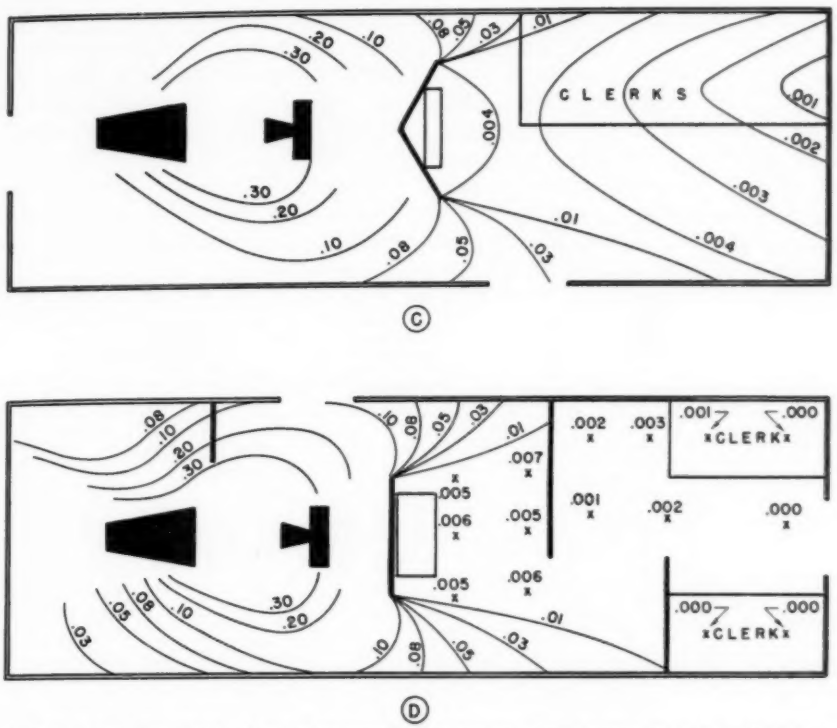

Fig. 5, C and D. Fields of radiation surrounding typical photofluorographic installations in mobile bus units of different floor plan. Section C may also be considered typical of portable installations in very small space. Isodose curves labeled to indicate radiation in roentgens per 100 average exposures.

Similarly, the isodose curves in the clerks' compartment at the rear of the bus also indicate that the radiation comes from the opposite wall. Here, however, the shape of the curves clearly demonstrates that the greater part of the radiation originates along the wall forward of the clerks' desks. This is to be expected, since the radiation striking the wall is more intense near the x-ray machine, and increasingly less intense toward the rear of the bus. These observations would appear to indicate that, in these cases also, the radiation encountered in the protected areas does not come through the screens, but around them.

The same conditions appear to prevail under somewhat different circumstances in the mobile unit illustrated by Figure 5B. Here, even though a protective screen is located at the front of the bus, behind the photofluorographic hood, radiation in the so-called protected region is relatively high. The reason for this is apparent from the orientation of the isodose contours, which show clearly that the radiation comes from the walls of the darkroom, which are in a position to receive relatively intense radiation from the primary scattering source (as well as a certain amount of direct radiation if the coning and tube alignment are not perfect). It should be noted that this bus unit was not designed to accommodate clerks' space. The radiation in the dressing-room area, while not serious to the transient patient, would be entirely too high for clerks required to work there.

Figure 5C illustrates another type of mobile unit, actually consisting of a portable photofluorographic machine installed in a bus. It represents, therefore, an example both of a mobile installation and a portable installation in a very small

room. The radiation patterns will be recognized as bearing the characteristics of the portable unit type.

The unit shown in Figure 5D needs no further comment beyond calling attention to the fact that the double barrier affords practically ideal protection to the clerks without interfering seriously with the flow of patient traffic. Additional wings in the ends of the technician's screen would undoubtedly increase protection in that area, although without them protection is not inferior to other installations.

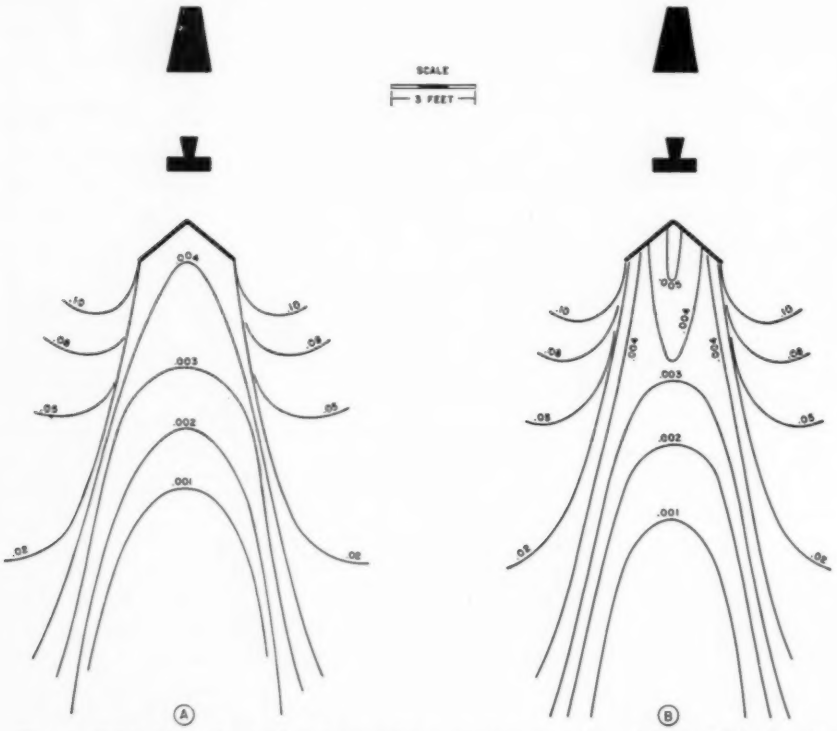

Fig. 6. Field of radiation behind the portable protective screen in typical photofluorographic installations. Isodose curves labeled to indicate radiation in roentgens per 100 average exposures. In the diagram at the right, note the radiation "leakage" resulting from inadequate shielding of the hinge.

As defined by the National Bureau of Standards (2), the maximum dose of general radiation to which an individual may safely be exposed over a period of time amounts to 0.3 r per week. With any specified number of average exposures, and at any position in the photofluorographic unit, it is possible to determine from the radiation field patterns presented above whether a person can remain within these safe exposure limits. For example, during a week in which 3,000 subjects are examined, the operator of the unit shown in Figure 5A (assuming that he stood squarely behind the screen as he should) would receive approximately 0.105 r (0.0035 × 30), or about one-third, of the permissible weekly dose. Similarly, a clerk working in the same unit under the same operating conditions would receive approximately 0.045 r (0.0015 × 30).

Conversely, the data provided by the isodose curves may be used to calculate the maximum number of average exposures which personnel at any given position can be expected to take before receiving the maximum dose of 0.3 r. For those con-

cerned with the operation of existing installations, this latter application of the isodose curve data will perhaps provide a more readily useful form of information. Figure 7, therefore, shows the relationship between the radiation intensity at any position and the number of exposures which would represent the weekly maximum dose of 0.3 r. As shown in this figure, the

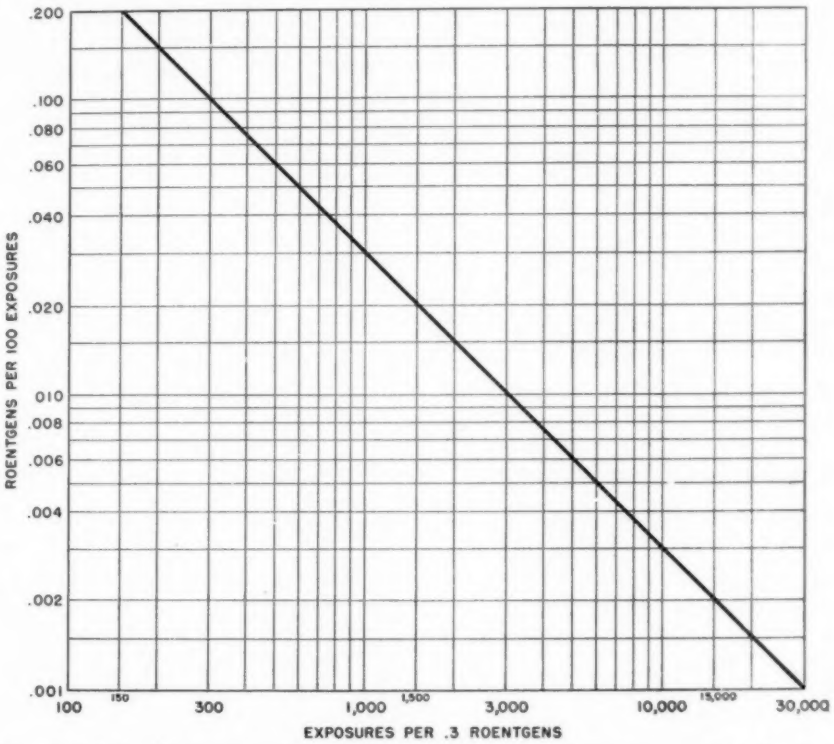

Fig. 7. Relationship between the amount of radiation received per exposure and the total number of allowable exposures (within the weekly tolerance dose of 0.3 r).

operator and the clerk in this particular example should be able to take 8,500 and 20,000 exposures per week, respectively, without exceeding the limit of 0.3 r. Obviously, reasonable safety factors should be introduced into estimates such as these, but it is evident that even the lower figure of 8,500 exposures is well in excess of any ordinary week's work.

Although the radiation field patterns do serve to indicate the radiation dosages to which photofluorographic personnel are exposed under given conditions, it does not necessarily follow that the predictable radiation dosages will not be exceeded, even to the point of unsafe operation. Actual measurements of the radiation received by individual members of photofluorographic mass survey teams by means of dental film badges do indicate that most personnel receive dosages well below the maximum limit of 0.3 r per week. And, indeed, these actual measurements do appear to agree rather closely with the dosages which can be estimated from the field pattern and the exposure load data. Nevertheless, a certain few appear to receive dosages not only in excess of those predicted, but often above the tolerance dose as well. It is therefore pertinent to consider the reasons which may underlie these occurrences.

A glance at any of the field maps reveals that there is a very sharp gradient in ra-

diation intensity along the line of the "radiation shadow" cast by the protective screen. As a result, the operator of a unit need move scarcely more than a few inches to change his dosage rate from perhaps 0.005 to 0.100 r per 100 exposures, a factor of 20 to 1. In other words, if he is well behind the screen, he can make some 6,000 exposures before reaching the 0.3 r limit. If he moves to the edge of the screen, however, he will receive the maximum allowable dosage in as few as 300 exposures. This clearly represents the difference between safe operation for even a busy week on the one hand, and hazardous operation for only a short time on the other.

Unfortunately, operators are strongly tempted to stand at the edge of the screen in order better to observe the subject during exposure. This is aggravated by the fact that the lead glass window in the screen is relatively small and not always at the right height for all operators. Furthermore, the exposure switch is so located that it is most often quite easy to actuate it by reaching around the screen. Similar reasoning obviously applies to the location of clerks' tables behind the screens of portable units and bus units. Of course, these conditions cannot in any way excuse the improper use of protective barriers by technicians and other personnel. They must, nevertheless, be considered fully in a realistic approach to the problem of protection against radiation hazards.

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SUMARIO

Los Campos de Irradiación Secundaria que Rodean la Instalación Fotorroentgeno gráfica

Los riesgos irradiatorios enlazados con el funcionamiento de instalaciones fotorroentgenográficas son mucho mayores que los confrontados en la radiografía con película grande. Para protección contra los mismos, precisa contar con un conocimiento adecuado de los campos de radiación que circundan a varias instalaciones. Teniendo eso presente, se estudió una gran variedad de instalaciones desde el punto de vista de la radiación presente tanto en las zonas sin resguardo como en las protegidas por pantallas. La radiación fué medida con un circuito de cámara de yonización integrante.

En general, los patrones a que se conforman los campos en las regiones fuera de las vallas protectoras son muy semejantes en toda clase de instalaciones, ya estén en cuartos abiertos o rodeadas de paredes muy limitadoras. No obstante, existe una región en la que dichos patrones varían ampliamente de una instalación a otra. Toscamente, esa región queda a lo largo de una línea que va desde el tubo de rayos hasta más allá del borde de la pantalla roentgenoscópica. No hay duda de que la intensidad de la irradiación en dicha región depende de la perfección del cono formado por el haz primario y de la exactitud con que encajen el haz y el centro de la pantalla roentgenoscópica.

Las intensidades que alcanza la radiación detrás de las pantallas y vallas de resguardo revisten naturalmente interés primordial, y se presentan observaciones realizadas en instalaciones de varias formas de aparatos portátiles y movibles, habiendo revelado las mismas patrones muy variados de radiación de acuerdo con el plano del piso.

Con cualquier número estipulado de exposiciones medias, y en cualquiera posición del aparato fotorroentgenográfico, es posible determinar por los campos de irradiación observados, si una persona puede o no permanecer inocuamente dentro de ciertos

límites de exposición. A la inversa, cabe usar los datos aportados por las curvas de isodosis para calcular el número máximo de exposiciones que puede esperarse que tome el personal antes de recibir la máxima dosis tolerable (0.3 r por semana).

Señálase que todos los mapas de los campos revelan una pendiente aguda en la intensidad de la irradiación a lo largo de la línea de la "sombra de radiación" lanzada por la pantalla protectora, de modo que el encargado de un aparato no tiene que moverse más que pocos centímetros para variar con un factor considerable la magnitud de su dosis. En otras palabras, si se halla bien atrás de la pantalla, puede verificar unas 6,000 exposiciones antes de alcanzar el límite de 0.3 r. Sin embargo, si se mueve al borde de la pantalla, recibirá la dosis tolerable máxima en no más de 600 exposiciones. Esas cifras representan la diferencia entre trabajo inocuo aun en una semana atareada, por un lado, y manejo arriesgado aun por poco tiempo, por otro. En todo estudio práctico del problema del resguardo contra los peligros de la irradiación, hay que tomar en cuenta estas observaciones.

Geometrical-Anatomical Factors and Their Significance in the Early X-Ray Diagnosis of Hip-Joint Disease in Children[1]

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THE COMMON HIP-JOINT disabilities of children, ranging from congenital dislocations and pelvic acetabular dysplasias of infancy to the slipped femoral epiphysis at the age of puberty, are often diagnosed only when the bony deformity is well advanced. Such late cases require complicated and prolonged surgical therapy to effect even a moderate degree of correction. The problem at hand is how to detect a very early hip-joint lesion on x-ray examination so that prompt and effective treatment can be instituted.

Ordinarily gross anatomical irregularities and changes in bone density in the femoral head and acetabulum are late signs of hip-joint disease. The approach to the problem of early x-ray diagnosis must therefore be founded on something other than shadow changes and marked deformities which are seen at a glance on the x-ray film. The examiner must come to regard the normal hip joints as finely balanced and bisymmetrical, and to recognize any asymmetry as denoting an anatomical imbalance or pathological process in the joint. Such a pathological process first manifests itself by disrupting the normal bisymmetrical balance of the pelvic ring and femoral heads. This early pathological disruption may be detected by noting certain subtle geometrical-anatomical disparities between the two hip joints.

The hip joints and the opposite sides of the pelvic ring normally constitute mirror images of each other. If one bisects them vertically from the symphysis pubis inferiorly, through the sacral promontory superiorly, it is evident that the two joints coincide and fit one over the other with great accuracy. It is like closing the pages of an open book. The right femoral head and acetabulum will coincide exactly with the left femoral head and acetabulum.

The three classical hip-joint diseases in children are: (*a*) congenital dislocation and subluxation of the hips in infancy; (*b*) Legg-Perthes' disease or avascular necrosis of the femoral head occurring at six to eight years of age; (*c*) slipping of the femoral epiphysis at puberty. All of these conditions can be determined roentgenologically with a high degree of accuracy rather early in their course. An anteroposterior view will often suffice when the fine geometrical relations of the hip joint are clearly understood and accurately measured.

The hip joints and femoral necks are best visualized in the anteroposterior view with the legs internally rotated to about 30° in order to bring the femoral necks into full view. This view must include both hips, in order that one may be compared with the other. A single hip view is misleading and practically worthless. The position of marked internal rotation brings out the full length of the femoral necks and affords an excellent comparative view of the femoral head epiphyses and their relationship to the acetabula. The lesser trochanter is rendered less visible by this maneuver. This positioning of the child's limbs is essential for accurate comparison of the two hip joints. It is sometimes necessary to strap the infant's pelvis to the cassette while an adult holds the legs, at the ankles, in internal rotation.

The pertinent general characteristics of a child's hips from infancy to puberty may be summarized as follows (1–3):

At Birth: There are no femoral head epiphyses until the age of two to ten months. When they

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Fig. 1. Normal hips and pelvis, of a child, aged 6 years. Note symmetry of the arc of the femoral heads and the transverse epiphyseal lines. The shaggy acetabular roof formed by the ilium is normal for this age.

appear, the epiphyses are round and of equal size. The angle of the femoral shaft with the femoral neck (shaft-neck angle) is very obtuse, *i.e.*, about 140° or more. The ischiopubic epiphysis is open and presents a wide gap in the inferior pubic ramus. The cotyloid notch is open throughout childhood. Although the acetabular margins are sharp and clear, the acetabular cavities are relatively large and shallow.

Early Childhood: The femoral head epiphyses are present and equal by the age of three years. They are definitely hemispherical in shape and present a horizontal epiphyseal line. The shaft-neck angle is still very obtuse. The ischiopubic epiphysis is starting to close the intervening gap, and one must not mistake this juncture for a fracture of the pelvic ramus. The acetabular margins are still sharp and clear.

Pre-School Age: The epiphyses are growing in proportion to the shaft. The shaft-neck angle has receded slightly with growth and age. The ischiopubic epiphyses fuse between the sixth and eighth year. The superior wall of the acetabular margin presents a shagginess which persists as a normal finding until puberty. Many of these features are shown in the pelvic film of a six-year-old child (Fig. 1).

Puberty: The well-formed epiphyses are definitely shifting from a horizontal to a vertical-oblique position, and the shaft-neck angle has receded to 130–125°, which approximates the angles of the normal adult. The superior acetabular margin remains irregular until twelve or thirteen years. The changes in the angle of the femoral neck and the obliquity of its epiphysis at puberty subject them to any shearing force. Subsequent endocrine changes, namely, rapid bone growth and increased body weight, can overstrain this epiphyseal junction, causing a "slipped epiphysis" in the plastic femoral neck. The lesser trochanter appears at eight to ten years, whereas the greater trochanter may appear anywhere from the third to the ninth year of age.

In a potential, partial, or complete congenital dislocation of the hip, the fundamental pathological mechanism is an acclivity, or abnormal obliquity of the acetabular roof, which provides little or no support to the femoral head. When the acclivity is combined with the presence of an excessive amount of fatty fibrous tissue in the acetabular cup, a definite outward

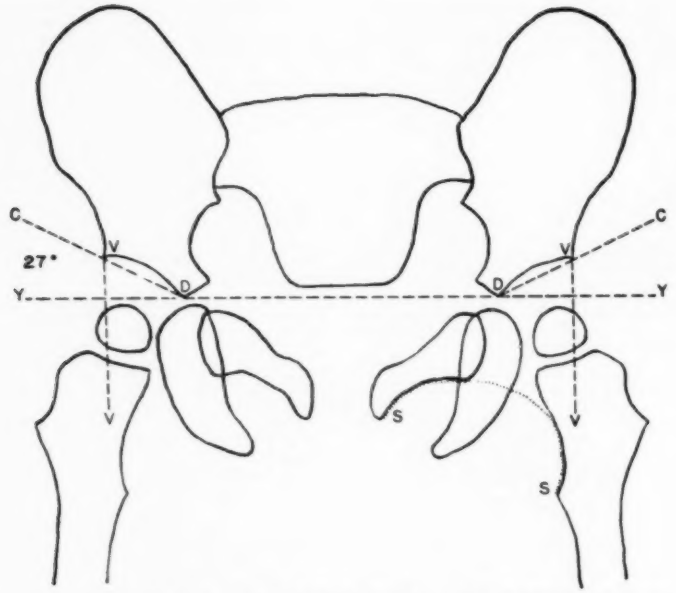

Fig. 2. Normal hips at the age of 10 months. The *Y* line passes transversely through the cotyloid notches. Note equality of size, shape, and position of the femoral heads as related to the *V Y* junction. Angle *CD Y* is the acetabular index. An angle over 30° is definitely pathological. The dotted line *SS* denotes the arc of Shenton's line.

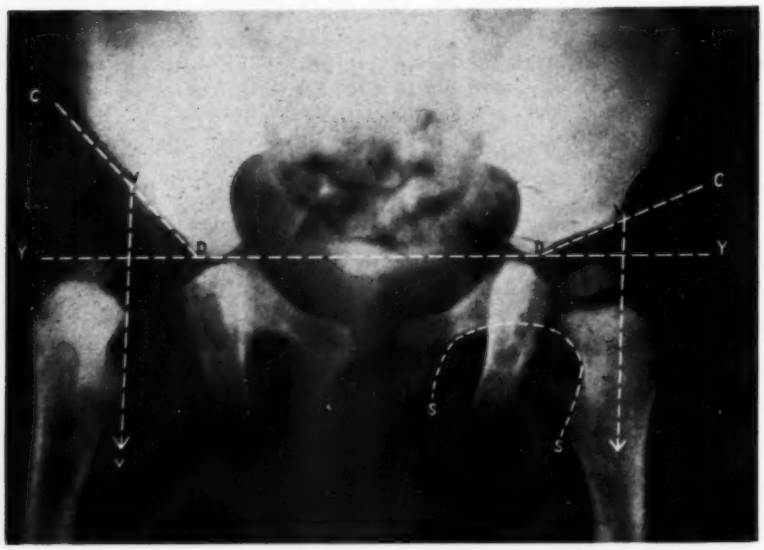

Fig. 3. Infant's hips at the age of 10 months. The right hip is subluxated and lies lateral to the *V* line, but inferior to the *Y* line. Compare the size and shape of the femoral heads. The acetabular angle on the right is 50°, on the left 22°. This is a hip dysplasia with lateral dislocation. Weight-bearing will eventually cause a complete dislocation of the right hip.

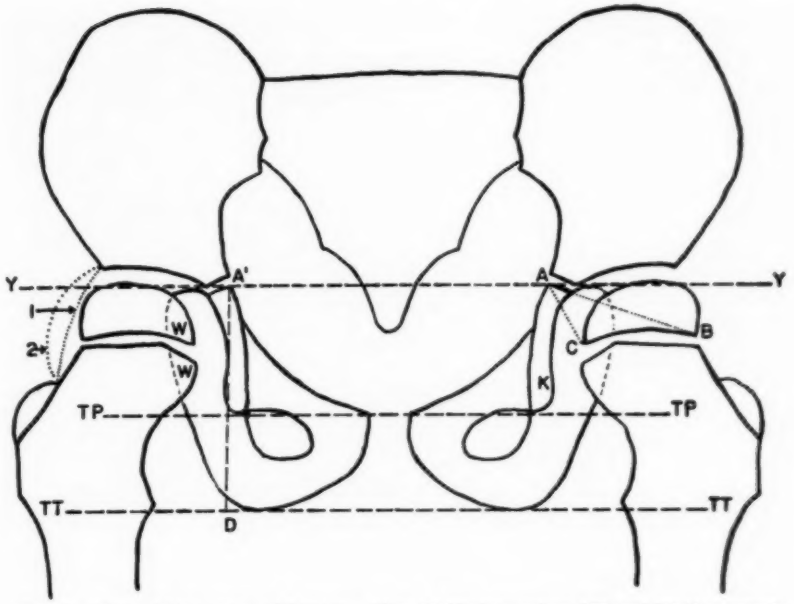

Fig. 4. Normal hips at age of 6 years. Note Köhler's teardrop (*K*) and Waldenström's overlap shadow (*WW*). The transverse lines are parallel because the sides of the pelvic ring are mirror images of each other. *TP* is the transverse pubic line; *TT* is the transverse tuberal line. Triangle *ABC* should be equal on both sides, as should line *A'–D*. A synovial effusion will distend the normal joint capsule (at 1) into a convex bulge, as shown at 2.

protrusion of the femoral head must occur. Thus the amount of protrusion depends on both the amount of fibrous tissue in the acetabular cup and the degree of obliquity of the acetabular roof.

In Figure 2, Hilgenreiner's lines demonstrate the basic anatomical relationship of the femoral head and acetabulum. The *Y* line is drawn horizontally through the cotyloid notches of the acetabula. The *V* line is dropped vertically from the lateral edge of the superior acetabular lip. The acetabular index is an angle formed by drawing a line from the cotyloid notch on the *Y* line to the superior acetabular lip on that side. Normally this angle (*CDY* in Figs. 2 and 3) is 20 to 27°. As the acclivity of the acetabulum increases, this angle must also increase. The more oblique the acetabular roof, the greater is its acetabular angle, and the less support it gives to the femoral head, with a resultant protrusion of the latter. When the only joint discrepancy is an increased acetabular angle, *i.e.*, 30° or more, Hart (4) has termed the condition "hip-joint dysplasia." Later, the dysplasia may result in a complete dislocation. Normally the epiphysis of the femoral head lies below the *Y* line and medial to the *V* line (contrast Figs. 2 and 3). In a subluxation, the femoral head lies lateral to the *V* line, but remains inferior to the *Y* line. When the protrusion or dislocation is complete, the head lies superior and lateral to the *VY* junction (Fig. 2).

Shenton's line is an invaluable anatomical guide in diagnosing hip dislocations. It is an arc drawn from the lesser trochanter along the medial-inferior surface of the femoral neck and joins the superior medial border of the obturator foramen (SS in Figs. 2 and 3). Normally, this is a regular, smooth arc, congruous on both sides. If the femoral head is subluxated or dislocated, Shenton's line on that side will present a marked irregularity in its outline, in sharp contrast to the smooth arc of the corresponding line on the normal side. While this particular sign is valuable, it may be hard pressed to reveal lateral pro-

Fig. 5. Early Legg-Perthes' disease in right hip. Note asymmetry of the obturator foramina, Waldenström's overlap shadow, and the slight but definite flattening of the lateral arc of the right femoral head. Transverse lines, as in Figure 4, will show divergence toward the normal side because the affected ischiopubic segment is hypoplastic.

trusion of a femoral head without superior displacement. In such instances the lateral protrusion is best detected with the aid of the *VY* lines shown in Figure 2, the iliofemoral line, and the overlap sign.

The arching iliofemoral lines can be accurately determined by tracing the silhouette of the ilium and femoral neck of one side on a piece of translucent paper, turning the tracing over, and superimposing its outline on a tracing of the joint of the opposite side. These tracings normally coincide. Any difference in the joint space or angle of one femoral neck will naturally be reflected in asymmetry of the superimposed tracings.

The valuable and practical sign known as "Waldenström's overlap" (5) consists of an upright crescentic shadow formed by the overlapping of the medial quadrant of the femoral head on the posterior lip of the acetabulum (WW in Fig. 4). In normal hips the overlap shadows are of equal size (see Fig. 1). If an inflammatory process within the joint cavity is present, or an acetabular acclivity exists, the femoral head on that side will be pushed laterally, thus diminishing the width of the overlap on that side (shown in Fig. 5).

By combining "Waldenström's overlap" with "Köhler's teardrop" (7), *i.e.*, the end-on view of the lower anterior acetabular floor (seen in Figs. 1 and 5), compass measurements may be taken from the cotyloid notch to both margins of the femoral epiphyseal line (*ABC* in Fig. 4). The sides of the triangle so formed should coincide with the triangle of the other hip. Inequality of the two triangles is an early indication of anatomical imbalance and hip-joint pathology.

Early diagnosis of Legg-Perthes' disease is extremely difficult and the condition is all too frequently overlooked on the x-ray film. The usually accepted signs of density changes in the femoral head and in the inferior portion of the epiphyseal line are often obscure and contradictory, and it is frequently necessary for the experts to delay judgment on such findings alone. An observation recently demonstrated by Outland (6) appears to solve the problem of

roentgen detection of early Legg-Perthes' disease. A quiescent synovitis is the first noticeable feature to occur in this disease. If one looks carefully at the soft-tissue shadow of the hip-joint capsule, one may notice its distention on the suspected side, as indicated by 2 in Figure 4. This synovial bulging is not diagnostic in itself. It merely serves put to the examiner on guard for further observations of the suspected joint.

Pathologically, the avascular reaction in the femoral head is accompanied by a peculiar plastic internal recession of the lower segment of the ischium and pubis. The geometrical imbalance so produced can easily be determined, for the lower pelvic segment is smaller and rotated internally as compared to its mate (7). Whether this phenomenon be due to a true hypoplasia of the inferior pelvic ring, to imbalance of the external rotator and hamstring muscles, or to a combination of the two, is not definitely known. Outland, however, has utilized this hypoplastic asymmetry of the inferior pelvic segment as a means of demonstrating early cases of Perthes' disease. With the varus recession of the inferior pelvic segment, the characteristic x-ray finding is a noticeable diminution in the size of the obturator foramen on the affected side. This inequality is well shown in Figure 5. Because the inferior pelvic segment is hypoplastic, a vertical line drawn from the cotyloid notch to the ischial tuberosity on that side (A'–D in Fig. 4) will be shorter than a corresponding line on the normal side. Likewise, the asymmetry of the inferior pelvic segment may be shown by drawing transverse lines across the ischial tuberosities of the two sides (TT in Fig. 4) or across the pubic tubercles (TP). Normally, TP and TT will be parallel, as shown in Figure 4. If one places these lines on an x-ray film showing early Legg Perthes' disease (Fig. 5), they will converge toward the affected side as a result of the decreased size of the inferior pelvic segment. Outland has further demonstrated that this is not due to a tilting of the x-ray tube.

Another early sign of aseptic necrosis of the femoral head is a slight flattening in the lateral arc of the femoral head. Unfortunately the average textbook illustration of Legg-Perthes' disease shows an advanced case with a completely necrotic, flattened, or fragmented head. If the geometrical signs here illustrated are judiciously used, it is hoped that more early diagnoses will result in early corrective treatment and avoidance of permanent hip-joint deformity.

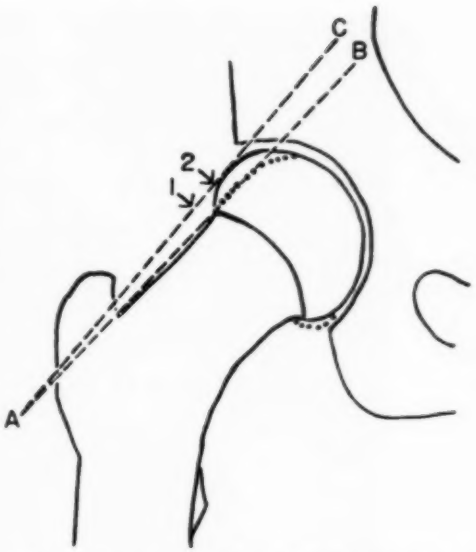

Fig. 6. A normal hip, at 14 years of age, shown in solid lines. Line AB intersects a superior lateral segment of the femoral head. Line AC is tangential to the arc of the femoral head. When slipping occurs (dotted line), the head descends and the neck rides upward. Line AC therefore disappears, to overlie line AB, which is now a tangential line on the femoral head, rather than an intersecting line. Arrows 1 and 2 show the usual concavo-convexity at the superior epiphyseal junction.

The last common hip-joint disease of children occurs before or at puberty and is commonly called "slipped femoral epiphysis." A neophyte can recognize the deformity when well advanced, but detection in the "pre-slipped" stage requires a keen appreciation of the mechanism of the slip and its early anatomical changes. Milch (8) described this process in 1937. The turning, or slipping, of the femoral head is in reality an anteversion of the femoral neck, with the head remaining fixed in the

Fig. 7. Early slipped femoral epiphysis of the right hip. Note widened epiphyseal line on the right with loss of concavity at this junction. If the line AB (shown in Fig. 6) is projected on this film, it will slightly override the arc of the head. Contrast these findings with the left hip.

acetabular socket. The earliest demonstrable geometric change which can be observed in the x-ray film consists of a loss of the normal concave-convex line (1 and 2 in Fig. 6) at the superior margin of the epiphyseal junction.

In Figure 6 the normal femoral head is shown by solid lines; the position of the femoral head in early slipped epiphysis is shown by dotted lines. In the normal hip the superior junction of the femoral neck and femoral head epiphysis exhibits a marked bulging convexity (arrow 2) where the lateral quadrant of the femoral head joins the femoral neck. As demonstrated by Watson-Jones (9) the line AB, drawn parallel to the upper border of the neck, intersects this segment of the superior and lateral quadrant of the femoral head.

As pointed out above, the femoral head remains in the acetabulum when the process of anteversion occurs. The plastic epiphyseal line starts to widen as this torsion mechanism occurs, and the femoral head then begins its downward and backward rotation within the acetabulum. This rotation deformity of the head increases the normal anteversion of the femoral neck and accounts for its external rotation deformity. These factors, coupled with the strain of weight-bearing in this weakened area, permit the femoral neck to start overriding the lateral arc of the femoral head, creating a certain degree of varus deformity in the relationship of the femoral neck and head. When this situation prevails, the line AB (Fig. 6) no longer intersects a definite segment of the femoral head, but instead is on a tangent with the arc of the "slipped" femoral head. Therefore, in more advanced cases the line AB will override the head completely.

Note how the more laterally placed (Fig. 6) line AC, present only in normal hips,

indicates the normal concave-convexity (arrows 1 and 2) at the superior epiphyseal junction. With an early degree of slipping of the epiphysis, the distance between lines AC and AB decreases until only line AB prevails in the position of the dotted "slipped" head. There is now no definite intersection of the arc of the femoral head—only a tangential relationship. Where arrow 1 had normally indicated a concavity and arrow 2 a convexity, the slipped epiphysis of the femoral head now shows only a gradually tapering, slightly convex line at this junction.

SUMMARY

1. A mechanical and functional approach to hip-joint anatomy is presented.

2. The concept of the normal hip joints as mirror images of each other is explained. Any asymmetry indicates mechanical imbalance and underlying joint abnormality.

3. Diagrams are included which illustrate the normal relationships of the hip joint as viewed on the x-ray film.

4. Examples are presented of the common hip-joint deformities in children from infancy to puberty.

5. The anatomical-pathological relationships of the hip joint are discussed.

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SUMARIO

Los Factores Geométrico-Anatómicos y la Importancia de los Mismos en el Diagnóstico Roentgenológico Temprano de las Afecciones de la Cadera en los Niños

Ordinariamente las irregularidades y alteraciones macropatológicas de la densidad ósea en la cabeza del fémur y la cavidad cotiloidea constituyen signos tardíos de enfermedad de la cadera. El diagnóstico temprano de la misma se basa en el reconocimiento del hecho que las articulaciones normales de la cadera son imágenes reflejas una de otra y que todo trastorno en la simetría de las mismas denota desequilibrio mecánico y un estado patológico subyacente.

Las tres clásicas dolencias coxales en la niñez son: dislocación y subluxación congénitas, en la primera infancia; enfermedad de Legg-Perthes, a la edad de seis a ocho años; deslizamiento (dislocación) de la epífisis femoral, en la pubertad. Todos esos estados pueden ser reconocidos en una etapa temprana si se comprenden claramente y miden con exactitud las delicadas relaciones geométricas de la articulación. Para lo último, lo más satisfactorio es una radiografía anteroposterior que abarque ambas caderas, tomada con las piernas en rotación interna, a fin de tener en plena vista los cuellos de los fémures, permitiendo también comparar las epífisis de las cabezas femorales y su relación con la cavidad cotiloidea en ambos lados. Las alteraciones en dicha relación con respecto a ciertas líneas y puntos fijos para cada uno de los estados menciones son ilustradas con diagramas y discutidas.

Lipomas of the Mesentery of the Small Intestine[1]

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Washington, D. C.

TRUE LIPOMAS arising primarily in the mesentery of the small intestine are extremely rare. In 1921 Wahlendorf (15) reviewed the literature and collected 132 retroperitoneal lipomas. Nineteen of these involved the mesentery of the small gut. The published data in the older literature are meager, however, and in some instances it is impossible to ascertain whether the tumors were true lipomas and whether they originated in the mesentery or involved it secondarily by extension from the adjacent retroperitoneal region. Considering only cases in which total or partial surgical extirpation was performed, Schmid (10) culled from the literature up to 1921 records of only 6 lipomas which arose primarily in the mesentery of the small intestine, In addition, he found 76 retroperitoneal lipomas and liposarcomas, as well as 23 mesenteric extensions from the retroperitoneal region. Only 4 of these are said to have been lipomas extending into the mesentery of the small intestine. From 1922 up to 1948, only 19 additional cases of lipoma arising in small intestinal mesentery were reported (1, 2, 3, 7, 8, 9, 11, 12, 14, 17).

The rarity of mesenteric lipoma and the desirability, from the point of view of prognosis, of distinguishing it sharply from retroperitoneal lipoma with secondary extension into the mesentery warrant the following case report and the subsequent discussion of the subject.

CASE REPORT

A 29-year-old white male was admitted for the first time to the Mt. Alto Veterans Hospital on Feb. 11, 1948, complaining of abdominal cramps, nausea, and vomiting.

Past History: At the age of eight the patient underwent an exploratory laparotomy for a similar episode. An appendectomy was performed at that time and his parents were informed that there was some malrotation of the colon. Occasional bouts of vomiting were experienced up to the age of sixteen.

Present History: The patient had been in good health until the afternoon prior to admission, when he began to "feel not up to par." At 7:30 that evening, one and a half hours after a heavy dinner, he had one formed bowel movement, followed at ten-minute intervals by two loose, gray, oily stools. Shortly thereafter he became nauseated and vomited repeatedly, though there was no hematemesis or melena. At 10:00 P.M. he began to suffer from abdominal cramps in the left upper quadrant, lasting for only half a minute but increasing progressively in frequency. The vomiting subsided during the following morning, but the cramps continued to recur every five or ten minutes.

Physical Examination: The patient was obese (229 lb.) and evidently in acute distress. No abdominal masses could be palpated. On auscultation, sounds characteristic of obstruction occurred synchronously with the cramping pains. Temperature was normal. A survey film of the abdomen revealed several distended loops of small bowel in the left upper quadrant.

Response to conservative therapy was prompt, and the acute phase rapidly subsided. Barium enema examination on Feb. 18 showed the cecum to be situated rather high, with a mesial direction. An abnormal annular shadow was noted in the terminal ileum about 10 cm. from the ileocecal valve (Fig. 1). This was a constant finding both on the retrograde study and on the six-hour film of Feb. 20 (Fig. 2).

By the tenth hospital day the patient was completely asymptomatic. He elected not to have definitive surgical therapy at that time. He was discharged with instructions to seek hospitalization at the first return of symptoms.

Subsequent follow-up examination of the gastrointestinal tract (April 12, 1948) showed no abnormalities of the stomach, duodenum, or jejunum. The peculiar ring-like configuration previously noted in the terminal ileum, 4 × 6 cm. in its largest dimension, was again observed following administration of barium by mouth (Fig. 3). It consisted of an oval marginal tract of barium about 1 cm. in width. Depending upon the degree of filling, it appeared

[1] From the Departments of Radiology and Surgery, Mt. Alto Veterans Hospital, Washington, D. C. Published with the permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the authors. Accepted for publication in October 1950.

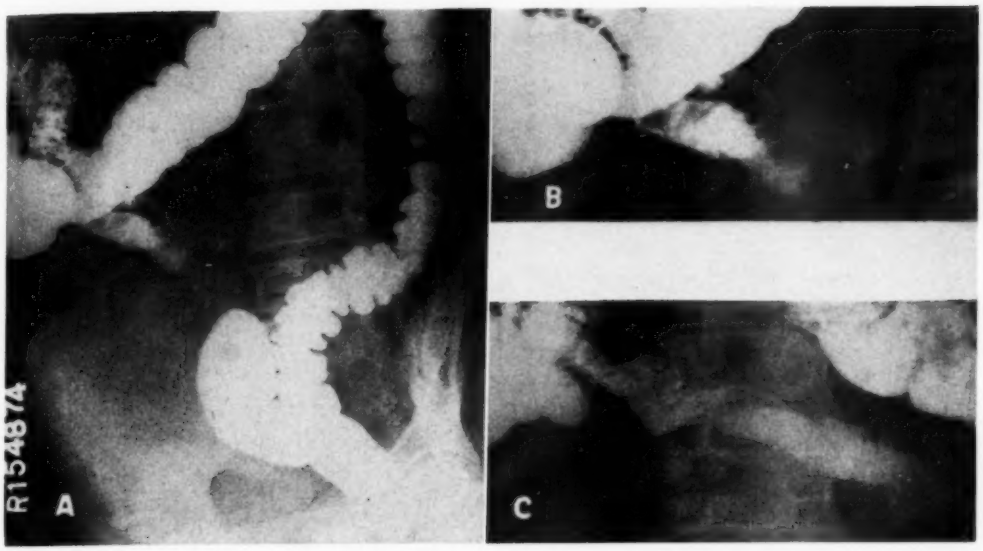

Fig. 1. Lipoma of the mesentery of the small intestine. Barium enema study showing annular shadow in terminal ileum.

A. Left anterior oblique view. B. Detail of same showing the peripheral ring-like configuration and the eccentric channel of barium. C. Detail of right oblique projection.

either as curved barium streaks or as a confluent band-shaped peripheral tract. The inside of this oval configuration was devoid of barium except for a central connecting channel. This segment of gut ran transversely, had well-defined borders, and exhibited an apparently normal mucosal pattern (Figs. 2 and 3). The portion of the ileum immediately proximal to the oval showed only momentary moderate distention when reached by a mass of barium. At such times the oblique views presented a configuration suggesting an attempt at intussusception into the center of the oval (Fig. 4). The oval and the afferent and efferent loops did not possess the usual mobility and appeared to be adherent.

A second abnormality was found in the middle third of the ileum. This loop of bowel was of a slightly larger caliber and coursed in a wide circular sweep of about 14 cm. diameter. The center of this circle was devoid of intestinal coils except for one loop in the form of a figure 8 (Fig. 5). This third abnormal segment, of about 25 cm. of ileum, was situated just proximal to the oval described above. The right margins of both limbs of the lower half of the figure 8 were completely fixed, compressed, and straightened. No intrinsic filling defects could be demonstrated. The mucosal pattern was intact, and the wall displayed distensibility, though of a diminished degree. However, the lower two limbs could not be made to approximate each other. They remained separated as if an abnormally thickened mesentery had intervened between them. The fusiform ribbon-like widening and the acute

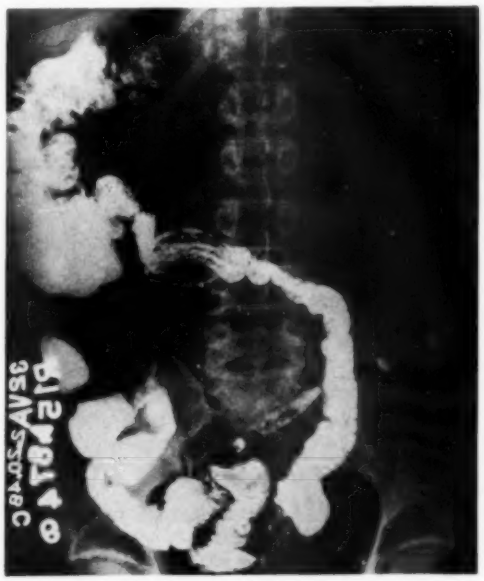

Fig. 2. Six-hour film confirming the constancy of the annular marginal streaks. They were produced by barium caught in the shelf-like rim of the thicker half of the circumference of the ileum. The centrally projected barium channel represented about one-sixth of the periphery, forming a residual eccentric tract in the deepest portion of the thinner half of the circumference.

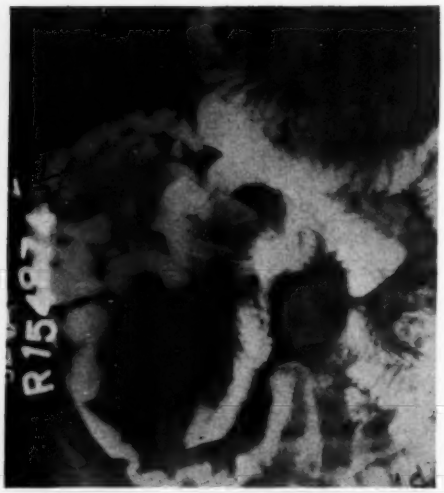

Fig. 3. Small intestinal study on April 12, 1948, again showing the annular peripheral configuration with the centrally projected channel. This was the site of the distal lipomatous mesenteric mass.

bend at the junction of these limbs and the inferiorly tented sharp margin were constant findings (Figs. 4 and 5). There was no delay in transit time. The propulsion through the compressed and flattened segments was maintained by somewhat hyperactive peristalsis. The barium reached the ileocecal valve in half an hour, and at three hours the head of the barium column was at the splenic flexure, and the tail at the proximal third of the ileum. At twenty-four hours no barium was retained in the ileum.

On Aug. 14, 1948, the patient was readmitted in acute distress. Following discharge from the hospital he had felt well and had lost 17 pounds in the interval by voluntary dieting. The current episode was preceded by several days of sluggishness of the bowels. The acute phase followed the intake of a heavy meal. The main complaints were nausea, vomiting, and abdominal cramps recurring every three minutes. Physical examination showed the patient writhing in acute pain, retching, and frequently drawing his legs up on the abdomen in an attempt to obtain relief. The temperature was 96.4°; white blood count 13,500, with 90 per cent polymorphonuclears.

A survey film of the abdomen revealed marked distention, with multiple fluid levels throughout the greater portion of the small intestine. The colon was devoid of gas, presenting a typical picture of small intestinal obstruction.

An exploratory laparotomy was performed the same day. On opening the peritoneum, a considerable number of dense adhesions were found involving the small bowel at the site of the old incision. The small intestine was considerably dilated, leading down into the right lower quadrant. A well-encapsulated lipoma, the size of an orange, was seen in the mesentery of the distal ileum. It was located at the mesenteric attachment of the gut. Another lipomatous mass of similar size was palpated farther down in the root of the mesentery, just proximal to the ileocecal junction. The distal 130 cm. of the ileum affected by the volvulus, plus its mesentery with the included masses, was excised down to within several centimeters of the cecal junction, and a side-to-side anastomosis was done. The patient made an uneventful recovery and has remained free from obstructive symptoms up to the present time.

Fig. 4. When the segment of ileum just proximal to the oval was distended with barium, the oblique view presented a configuration as if there were an attempt at intussusception into the center of the oval.

Pathologic examination disclosed oval dilatation of the distal 8 cm. of the specimen. The next 3 cm. were narrowed and constituted the actual node of the 360° clockwise twisting about the adjacent lipomatous mass. The distal mass (9 × 6 × 6 cm.) was of a dark yellow color with a distinct lobulation and cleft-like configuration on its anterosuperior aspect (Fig. 6A). Several lymph nodes were incorporated in it. The second mass (10 × 5.5 × 5.5 cm.) was of light yellow color and consisted of fairly homogeneous and much larger lobules than normal fat. It was situated immediately adjacent to the bowel attachment in the mesentery of the ileum, 23 cm. from the end of the specimen. The small gut ran over the surface of this lipoma and presented a flat, ribbon-like fusiform dilatation measuring 8 × 3.5 cm. The inferior point was fixed with a sharp bend corresponding to the x-ray configuration (Figs. 6B and C). The intervening 10 cm. segment of ileum between the two lipomatous

masses was partially compressed by the heavy deposit of normal-looking adipose tissue in the mesentery.

DISCUSSION

The two fatty masses encountered in the mesentery of this patient represent a lipomatous mass and a true lipoma. There is as yet no single histologic or chemical criterion for differentiating between tumor fat and depot fat (13). Clinically, in the presence of emaciation, one may be certain that a large fatty mass is an autonomous lipoma and not adipose tissue. In the absence of emaciation, the differentiation can be made only on the basis of the gross appearance and structure of the mass. The true lipomas are encapsulated, have a more homogeneous fatty structure, and consist of large lobules. The lipomatous mass of adipose tissue is less well encapsulated, the lobules are smaller and indistinct, and may have incorporated preexisting lymph nodes. In our patient the proximal mass at the mesenteric attachment of the ileum was a true lipoma; the distal mass in the root of the mesentery was a lipomatous mass of adipose tissue.

Roentgenologically fatty infiltration of the mesentery of the small intestine, whether it be by a true lipoma or by a lipomatous mass of adipose tissue, may produce four distinct effects. The first three of these were manifested in our roentgenograms.

1. *Elongation and compression of the small intestine:* As the fatty mass grows in all directions, it will not only compress the surrounded segment of gut but also tend to elongate it. This is well illustrated (Fig. 5) by the upper and mesial limb of the figure-8 formation. Such compression and elongation were described by Madelung in 1881 (4).

2. *Fusiform ribbon-like thinning of the intestinal wall:* As the closely applied lipoma enlarges, it stretches and thins out the apposed wall of the gut. The fusiform widening of the attenuated ileal wall is clearly portrayed at the junction of the lower limbs of the figure 8. The bend and the inferiorly tented sharp margin were produced by a folding of the thin, ribbon-like ileal wall upon itself at a point of adherence to the lipoma. A description of this effect—but without roentgenographic illustration—may be found in the report by Bass (1).

Fig. 5. A loop of the middle third of the ileum in the form of a figure 8. The fusiform ribbon-like widening and the acute bend, as well as the inferiorly tented sharp margin of the lower limb of the figure 8, were constant findings. This was the site of the proximal mesenteric lipoma. Also note compression of upper and mesial limb of the 8-configuration.

3. *Oval dilatation with eccentric (but centrally projected) channel formation:* The oval ring-shaped configuration depicted in Figures 1, 2, and 3 was found to consist of dilatation and variable thinning of five-sixths of the circumference of the distal ileal wall. Two factors were operative in its causation. The major element was the hydrodynamic factor which produces dilatation distal to a point of obstruction to the flow. This oval was located just beyond the second nodal point of twisting about the distal lipomatous mass. The second factor was the adherence of a portion of the wall to the mass. One half of the circumference of the wall was considerably

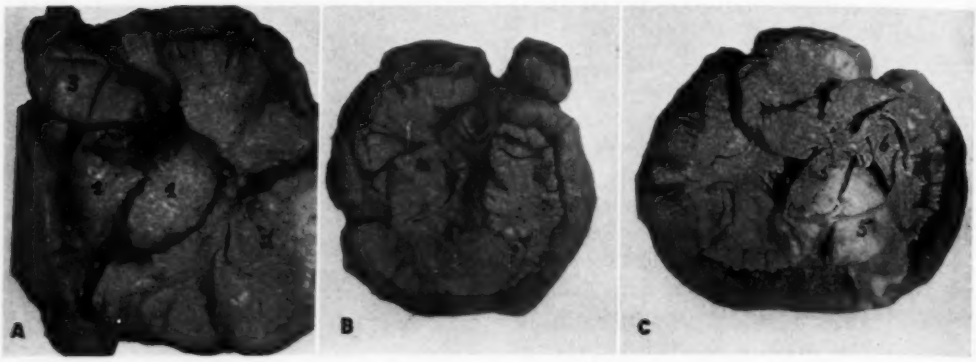

Fig. 6. Resected specimen. A. Anterior view (slightly retouched) showing the distal lipomatous mass (1, cut in half), the narrowed 3 cm. of the ileum (2) at site of the twist, and the distal oval dilatation (3). B. Anterior view depicting the flat, ribbon-like (4) fusiform dilatation of the ileum at site of the lipoma. C. Posterior view. The lipoma (5) is seen shelled out and tied with a string. The dilated segment of ileum has been lifted upward to show its cupped undersurface (6).

thinned out. The other half showed stretching with only slight thinning and exhibited a shelf-like periphery with fairly normal wall thickness. When this oval dilated segment was compressed and flattened, only a back-eddy of barium could outline its shelf-like peripheral rim in a streaky manner. The eccentric channel, representing only one-sixth of the circumference (*i.e.*, the deepest portion of this thin segment), is superimposed as an apparently central tract. Its true peripheral position is portrayed in the oblique views.

4. *Relative radiolucency of the mass:* This effect was not manifested in our case, since the lipomas were comparatively small. Though several very large roentgenologically diagnosed retroperitoneal lipomas are on record, Selman (11) recently reported the first mesenteric lipoma roentgenographically visualized. This occurred in a four-year-old child and measured 14 cm. in diameter.[2]

Mesenteric lipoma may also cause separation of the intestinal loops and displacement. However, massive contiguous displacement of the small gut to one side is more likely to occur in retroperitoneal lipoma.

The most common complications are chronic intermittent or acute obstruction and volvulus. Our patient had four of the five conditions—listed by Nabel (5)—each one of which alone predisposes to volvulus. First, he had incomplete rotation of the cecum and ascending colon, which results in approximation of two points on the mesentery. Secondly, adhesions were found secondary to the lipomas, as well as those due to the appendectomy and laparotomy in childhood. Thirdly, mesenteric tumors, *viz.* lipomas, *per se* tend to produce torsion. Fourthly, disappearance of fat in abdominal wall, mesentery, and omentum, whether as a result of starvation or a reducing diet, allows greater mobility of the intestinal loops. Nabel further emphasized the previously expressed view that the sudden filling of the empty intestine with massive amounts of foodstuff may act as an exciting cause of volvulus. Both episodes of obstruction in our case were preceded by heavy intake of food. With so many factors present, one can only conjecture—but not definitely prove—which ones were operative and which played the major role in the production of the volvulus.

Retroperitoneal lipomas and especially those originating n the perirenal region are notorious for their tendency to recur and to exhibit sarcomatous elements (6). In

[2] Since the submission of this paper for publication, a further case with distinctive roentgenographic features has been reported by Everett and Fink (Radiology 56: 370, March 1951).

contradistinction to retroperitoneal fatty tumors, no authentic liposarcoma originating from the mesentery of the small intestine is to be found illustrated in the literature. Closer scrutiny of the case reported by Waldeyer (16) in 1865 shows that one cannot exclude the possibility of an extension into the mesentery from the retroperitoneal region. In the case reported by Rankin and Major (8), the lipomatous element was evidently a minor one, if at all an integral part of the malignant tumor.

SUMMARY

1. Lipomas primarily arising in the mesentery of the small intestine are of extremely rare occurrence.

2. A case of a lipomatous mass and a true lipoma arising in the mesentery of the ileum is described.

3. Roentgenographically this case exhibited three of the four x-ray effects produced by mesenteric lipoma, namely: elongation and compression of the gut, fusiform ribbon-like thinning of the intestinal wall, and oval dilatation with an eccentric (but centrally projected) channel within a ring-like configuration. Owing to their small size, the lipomas did not show relative radiolucency.

4. Four factors, each one of which alone predisposes to volvulus, were present, *viz.*: incomplete rotation of cecum and ascending colon, adhesions, mesenteric tumors (lipomas), and loss of fat as a result of dieting. There were two recent episodes of intestinal obstruction. Both were preceded by heavy intake of food, which may have constituted the factor precipitating volvulus.

5. Lipomas arising in the mesentery of the small intestine—in sharp contrast to those arising in retroperitoneal and especially in the perirenal region—do not have the tendency to exhibit sarcomatous elements. In view of their usually small or moderate size and amenability to complete extirpation, a good prognosis may be rendered.

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SUMARIO

Lipoma del Mesenterio del Intestino Delgado

Los lipomas asentados primariamente en el mesenterio del intestino delgado son sumamente raros. El caso descrito es de tumefacción lipomatosa y verdadero lipoma originado en el mesenterio del ileon.

Roentgenográficamente, el caso mani-

festaba tres de los cuatro efectos producidos por el lipoma mesentérico, a saber: alargamiento y compresión del intestino; adelgazamiento fusiforme en tira de la pared intestinal; y dilatación oval con un conducto excéntrico (mas proyectado centralmente) dentro de una configuración anular. Debido a su pequeño tamaño, los lipomas no revelan radiolucencia relativa.

Había presentes cuatro factores, cada uno de los cuales predispone al vólvulo, a saber: incompleta rotación del ciego y del colon ascendente, adherencias, tumores mesentéricos (lipomas) y pérdida de tejido adiposo a consecuencia de la dieta. Había habido dos episodios recientes de oclusión intestinal, ambos precedidos de fuerte ingestion alimenticia, lo cual puede haber constituído el factor que precipitó el íleo.

Los lipomas asentados en el mesenterio del intestino delgado—en decidida contraposición a los implantados en la región retroperitoneal y sobre todo perirrenal—no muestran tendencia a manifestar elementos sarcomatosos. En vista de su tamaño por lo general pequeño o moderado y prestarse a la extirpación total, puede ofrecerse un buen pronóstico.

Surface Activity Following Administration of Radioactive Phosphorus[1]

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New York, N. Y.

SOON AFTER radioactive phosphorus became available for medical research, it was found that the uptake following administration to animals or man is greater and more rapid in metabolically active tissue, such as regenerating liver, bone marrow, spleen, and malignant tumors, that eventually it becomes widely distributed, with its greatest concentration in bone, and that the labeled phosphorus is retained longer in neoplastic tissues than in equally active normal tissues (5, 6, 11). The radiophosphorus was found in higher concentration in the nuclei of normal or neoplastic cells than in the cytoplasm (1, 21, 22), and within the nuclei most of the P^{32} was in the nucleoprotein (16). It was concluded that the higher specific activity and turnover in tumor tissue was related to increased mitotic activity.

By assaying weighed amounts of tissue, it was shown that the uptake in neoplastic breast tissue was two to seven times that in normal breast tissue, while lymph nodes with metastases were three to four times more active than normal nodes (7). Studies were extended to the measurement of activity on the surface of the skin, and it was reported that one case of melanoma and two cases of mycosis fungoides showed increased activity over the involved areas, compared to normal areas (15). Low-Beer and his co-workers (13), carrying out systematic surface measurements of beta activity after administration of P^{32}, reported increased surface activity over a limited number of a wide variety of superficial and subcutaneous lesions, both neoplastic and inflammatory. In a series of 41 malignant breast tumors subsequently reported (17), they found at least 25 per cent higher activity over the involved breast than over the normal, following intravenous administration of P^{32}.

These results suggested the possibility of a simple technic for differentiating benign from malignant breast tumors, and for determining the existence of lymph node metastases. It seemed possible that, after a suitable period following the administration of radiophosphorus, one could measure the beta activity on the skin compared to an uninvolved area, and thus diagnose a malignant process. An obvious objection is that the very short range of the P^{32} beta particles in tissue may make the observed activity dependent on the thickness of the overlying tissues. Nevertheless, because of the simplicity and rapidity of the suggested technic, the present study was undertaken to evaluate its diagnostic possibilities for superficial lesions. Attention has been limited to superficial lesions, since it is virtually impossible to detect by surface observations beta activity arising at a depth of more than 5 mm.

SELECTION OF CASES

This report presents the results of surface measurement of beta activity on 30 patients (see Tables I and II). For the study of surface activity over lymph nodes, patients were selected with obvious superficial lymph node metastases, axillary or supraclavicular, or both. For the study of activity over malignant tumors, inoperable cancers of the breast were chosen, in which the superficial skin layers were

[1] From the Department of Radiotherapy (Dr. William Harris, Chief) and the Physics Laboratory (Dr. Sergei Feitelberg, Physicist in Charge), the Mt. Sinai Hospital, New York. This work was supported in part by the Goldfine Fund. Accepted for publication in October 1950.
[2] Now in Department of Radiology, Beth Israel Hospital, New York.

TABLE I: SUMMARY OF SURFACE ACTIVITY MEASUREMENTS IN 24 CASES FOLLOWING ADMINISTRATION OF P^{32}

Case	Diagnosis	Remarks	Relative Surface Activity, 1 day			
			Breast	Axillary Nodes	Supra-Clav. Nodes	Other Areas
4. J. P.	Scirrhous carcinoma of right breast, superficial but not ulcerated, with metastases to right axillary nodes	Higher surface activity over lesion as compared with adjacent uninvolved area and with the normal breast. Nodes not studied. Quantitative data not conclusive				
5. R. N.	Scirrhous carcinoma of left breast (ulcerated) with extension to left axilla	Higher surface activity over ulcerated area and axilla relative to uninvolved breast	3.4			
10. P. G.	Carcinoma of left breast, superficial, not ulcerated, with metastases to left axillary nodes	Higher surface activity over involved breast as compared with contralateral uninvolved (2 studies). Surface activity over involved axillary nodes less than uninvolved. Frontal, sternal, thigh, and skin surface activity observed. Symmetry observed	5.1 4.3	0.8		See Table II
11. E. A.	Scirrhous carcinoma of right breast (ulcerated) with metastases to right axillary nodes	Higher surface activity over lesion relative to uninvolved breast. Slightly higher surface activity over involved axillary nodes relative to uninvolved contralateral	3.1	1.2		
12. V. H.	Anaplastic carcinoma of left breast (ulcerated) with metastases to left axillary nodes	Higher surface activity over lesion relative to uninvolved breast (3 studies). No significant difference in surface activity over involved and uninvolved axillary nodes. Normal breast varies in surface activity with highest activity over nipple	4.8 5.3 5.0	0.93		
13. R. A.	Anaplastic carcinoma of left breast (ulcerated)	Higher surface activity over lesion relative to uninvolved breast. Normal breast nipple has twice surface activity of other areas of same breast. Thighs and shins show symmetrical surface activity	4.0			
17. S. P.	Recurrent en cuirasse nodules post radical mastectomy for scirrhous carcinoma of right breast	Higher surface activity over skin nodules relative to adjacent uninvolved skin and contralateral symmetrical skin area. Nipple has twice surface activity of other areas of normal breast				2.5 Also see Table II
6. C. J.	Squamous cell carcinoma of lung with metastases to left supraclavicular nodes	Higher surface activity over involved supraclavicular nodes relative to adjacent uninvolved skin and contralateral uninvolved supraclavicular region. Inconclusive quantitatively				

TABLE I: SURFACE ACTIVITY MEASUREMENTS IN 24 CASES FOLLOWING ADMINISTRATION OF P^{32}—*cont.*

Case	Diagnosis	Remarks	Relative Surface Activity 1 day			
			Breast	Axillary Nodes	Supra-Clav. Nodes	Other Areas
7. P. F.	Small cell carcinoma of lung with metastases to right supraclavicular nodes	Approximately same surface activity over involved and uninvolved nodes			0.94	
8. T. H.	Small cell carcinoma of lung with metastases to right supraclavicular nodes	Approximately same surface activity over involved supraclavicular node and contralateral normal area. Positive radioautograph from involved node			0.97	
9. M. S.	Squamous cell carcinoma of lung with metastases to right supraclavicular nodes	Higher surface activity over involved supraclavicular nodes relative to uninvolved supraclavicular region			1.3	
26. A. S.	Adenocarcinoma of lung	Surface activity of oral mucosa and thighs observed				3.5
3. A. C.	Metastatic squamous-cell carcinoma, anterior chest wall nodules; primary in oral mucosa	Higher surface activity over chest wall nodule relative to adjacent normal skin. Higher surface activity observed over involved nodule within one minute after injection. Positive radioautograph obtained from biopsy of involved nodule				3.5
1. M. D.	Metastatic scirrhous carcinoma, right supraclavicular nodes; primary undetermined	Higher surface activity over involved nodes relative to left supraclavicular region. Inconclusive quantitatively				
2. T. G.	Chronic lymphatic leukemia	Higher surface activity over superficial leukemic infiltrations relative to adjacent or symmetrical normal areas. Inconclusive quantitatively				
14. A. C.	Chronic lymphatic leukemia; submandibular and axillary nodes involved	Surface activity (relative to sternum) over involved nodes high; highest over submandibular. Surface activity of frontal area, breasts, nipples, thighs, shins, anterior abdominal wall symmetrical		1.5		2.4
19. M. K.	Polycythemia vera	Surface activity observed after injection of red cells tagged with P^{32} (see text)				
29. M. M.	Polycythemia vera	Surface activity curve similar to other patients. P^{32} in form of phosphate solution. (See text for comparison with results in Patient 19)				
16. E. W.	Multiple myeloma, scalp nodules	Surface activity over scalp nodules not higher than adjacent uninvolved areas. (Proved to be sterile fluid collection rather than myeloma infiltrations)				1.0

TABLE I: SURFACE ACTIVITY MEASUREMENTS IN 24 CASES FOLLOWING ADMINISTRATION OF P^{32}—*cont.*

Case	Diagnosis	Remarks	Relative Surface Activity 1 day			
			Breast	Axillary Nodes	Supra-Clav. Nodes	Other Areas
15. H. M.	Squamous-cell carcinoma of cervix (stump)	Surface activity of frontal, shins, thigh areas symmetrical. Breasts and nipples surface activity not symmetrical				See Table II
27. T. L.	Carcinoma of pyriform sinus	Surface activity of oral mucosa and thighs observed				
18. M. L.	After right radical mastectomy for adenocarcinoma of breast with axillary node metastases	Frontal area, sternum, breast, nipple, thighs, shins observed for relative surface activity and symmetry. Frontal areas, thighs, and shins symmetrical				See Table II
24. H. U.	After radical mastectomy for duct carcinoma of the breast	Surface activity of oral mucosa and thighs observed				
30. L. L.	Diffuse metastatic carcinoma	Surface activity observed after injection of red cells tagged with P^{32}. (See text)				

already involved by ulceration or lymphatic spread. A few patients with other superficial lesions were studied. Still others were selected for studies of activity in oral mucosa and cervix, or for studies of normal areas, or of activity as a function of the time. Because of the absence of information on late radiation effects, only patients with proved malignant tumors were studied.

INSTRUMENTATION AND DOSAGE

A Geiger-Müller tube with a thin mica window at one end was used for all measurements. Several such tubes were tried, until the method was standardized on the most convenient, a tube with a 2.0-cm. diameter window 3.2 mg./cm.^{2} thick, having an outer diameter of 2.5-cm.[3] A few strands of heavy wire were hard-soldered to one end of a brass sleeve, which fitted over the tube to protect the window from breakage. Thus protected, it was used for oral and cervical mucosa as well as on skin areas.

The radiophosphorus, obtained on allocation from the Oak Ridge Laboratory of the U. S. Atomic Energy Commission, was standardized, made isotonic with sodium chloride, autoclaved, and tested for reactions by intraperitoneal injection into mice. It was administered by intravenous injection in all except a few cases, in which it was given orally. No difference in surface distribution was expected or observed between these two methods of administration, except that the increased excretion following oral administration resulted in somewhat lower surface counts for a given dose.

Satisfactory surface counts were obtained following the administration of doses ranging from 35 to 1,000 microcuries. The most convenient dose was found to be about 500 microcuries (0.5 millicurie). This amount gave an average surface activity of a few thousand counts per minute in the counter with the 2-cm. window. With lower dosage the surface

[3] Philips tube, type 62019, a commercially available G-M tube of unusual stability. Near the completion of this work a similar tube with a 0.6-cm. diameter window and 1.3-cm. outside diameter was made available by the same company, under the number 201N. Such a tube will sample relatively small skin areas when desired, and is used for measurement of cervix activity without discomfort to the patient.

activity was less and a longer time was required to obtain satisfactory statistical accuracy, while a much higher dose, giving a higher surface activity, produced a counting rate too high for the Geiger tube.

All patients had complete blood counts prior to receiving the P^{32}. Leukopenia was considered a contraindication to the administration of radioactive materials.

TABLE II: SURFACE ACTIVITY OF CERVIX

Case	Ratio, Cervix to Thigh	Remarks
17. S. P.	3.4	Normal cervix
18. M. L.	3.3	Normal cervix
20. E. B.	4.3	Normal cervix
21. I. M.	4.6	Normal cervix
25. J. N.	2.7	Normal cervix
10. P. G.	3.6	Cervicitis. Repeated biopsies and Papanicolaou smears negative for carcinoma
23. E. T.	2.2	Squamous-cell carcinoma of cervix, one month after completion of radiotherapy
15. H. M.	6.5	Squamous-cell carcinoma of cervix, stump, untreated
	3.7	Fourteen months after completion of radiotherapy
22. C. A.	10.4	Squamous-cell carcinoma of cervix, untreated
28. W. T.	12.7	Squamous-cell carcinoma of cervix, untreated. Activity measured over involved portion of cervix only
	3.6	Same patient, activity measured over apparently normal portion of cervix at same time
	5.6	Same patient, three months after completion of radiotherapy. Activity measured over previously involved area

TECHNIC

When an end-window Geiger tube is placed on the skin of a patient previously given P^{32}, a certain beta activity will be observed, which may be recorded in counts per minute. This observed counting rate cannot be interpreted as a direct measure of the uptake in the underlying tissues, for two reasons: an unknown part of the activity comes from the circulating blood, and the tissue absorption of the beta particles is so great that the observed activity must come almost entirely from 2 or 3 mm. of cutaneous and subcutaneous tissue.[4] We have therefore avoided the term—and the concept of—"uptake," by referring to our results as "surface activity." The ratio of observed activities at two different sites is then referred to as "relative surface activity," or simply as r.s.a. Thus, an r.s.a. of 1.00 would indicate the same surface activity in the two sites, while an r.s.a. of 1.25 would indicate a surface activity 25 per cent higher at the test site than at the control site.

The natural background count of the Geiger counter was in all cases determined and subtracted from the observed counting rate before computing relative surface activity. Since radioactive disintegration is a random phenomenon, there is associated with N observed counts a standard error of $\sqrt{N}$ counts, which is indicated by writing $N \pm \sqrt{N}$. Using this and other conventional statistical methods, the standard errors of all surface activities and relative surface activities were computed. A deviation equal to or greater than three standard errors was considered to be significant (*i.e.*, 1.05 ± 0.07 was not considered to differ significantly from unity, while 1.25 ± 0.07 was considered significant). These standard errors refer only to radioactive fluctuations and were used only to insure that sufficient counts were taken to get a valid estimate of the counting rates at the sites chosen. They are not given in this report. Where standard errors are indicated below, they have been determined by the agreement of the data between different patients, and include not only radioactive fluctuations but also the much larger biological fluctuations.

A standard source of P^{32} was used as a reference to check the sensitivity of the Geiger tube and its circuits when observations were continued over many days on one patient.

[4] P^{32} decays with a half-life of 14.3 days, emitting pure beta radiation. These beta particles have a maximum penetration in tissue of about 8 mm., and an average penetration of about 2 mm. Unpublished measurements by one of us (R. L.) indicate that the activity of a source of P^{32} beta particles will be reduced to 5 per cent by 2.9 mm. of overlying tissue, while if the source is situated at the surface, 95 per cent of the activity originates in the first 3.2 mm.

The technic of observation, as developed on the first six and used on most of the remaining patients, was as follows: All sites to be studied were marked before injection and numbered in some convenient sequence. A short background count was made at each site just prior to injection. The injection was made at a known time, and counts were taken for fixed intervals (usually twenty seconds) at each of the marked sites in sequence. This was continued for two to three hours, the time interval for the collection of counts being gradually lengthened up to one to two minutes. The counting sequence was then repeated daily. When it was not desired to observe the activity during the first day, observations were made one day after injection, and in some cases on subsequent days as well.

ACTIVITY CURVES

Since the published literature offers little guide as to the most favorable time after administration for observing surface beta activity, this point was investigated by the technic described above. In Figures 1A and 1B are shown schematic surface activity curves, counts per minute being plotted against time after administration. The curves shown are more or less typical of results for all patients and can be described in general as follows: The counting rate at the skin increases within ten seconds after injection, rises rapidly to a maximum value in three to fifty minutes in all areas, decreases fairly rapidly for an hour or two, and at a relatively constant rate thereafter. The exponential decrease in strength of a P^{32} source is shown in Figure 1B, as a straight

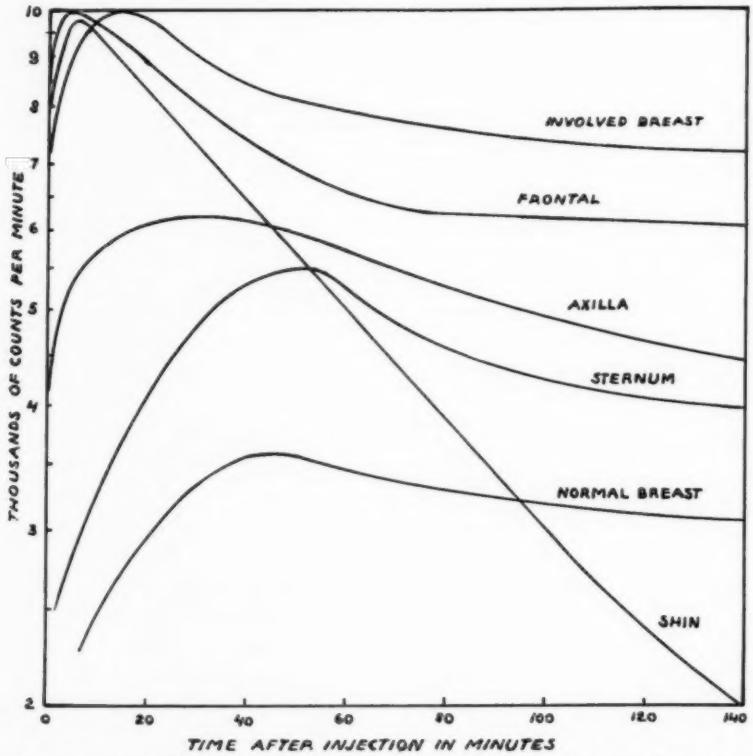

Fig. 1A. Idealized curves of observed surface activity during first two hours after injection of 1 mc. of P^{32}.

line, since the scale of ordinates is logarithmic. The decrease in surface count after the first few hours also appears, in general, as a straight line on this graph, though of greater slope than the line representing radioactive decay of P^{32}. The increase in slope is due to metabolic elimination of the phosphorus. Since this observed rate of decrease is represented by a straight line, it is an exponential function of the time, and can be characterized by an "effective half-life," which is in general shorter than the radioactive half-life of 14.3 days. The effective half-lives were computed and, generally speaking ranged from five to fifteen days. In drawing Figure 1B, representative values of the effective half-lives were used.

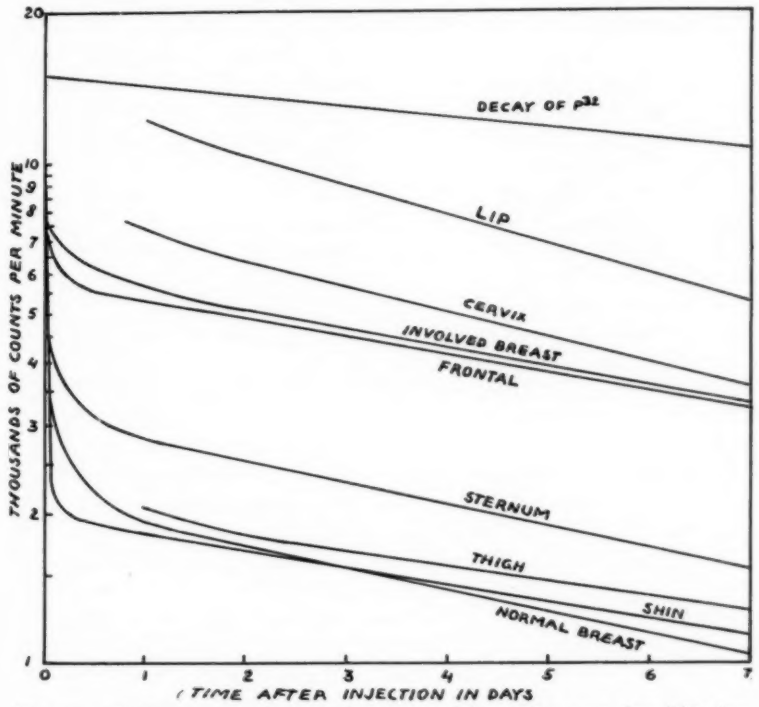

Fig. 1B. Idealized curves of observed surface activity during seven days following injection of 1 mc. of P^{32}.

There is considerable variation between the surface activity curves of different patients. For that reason, it seemed to be useful to present the idealized, schematic curves of Figures 1A and 1B instead of the actual observations, since all showed these general features. It must be realized that no patient gave activity curves as regular as those shown, nor do the numerical values represent exactly any that were observed. In a number of patients, the rate of decrease of surface count was more rapid than the final exponential value until about the second day, after which it became exponential. This did not change the relative surface activities appreciably. In a few patients there were sudden changes in the surface activity several days after administration, such that effective half-lives could not be assigned.

Schematic relative activity curves have been computed from the schematic surface activity curves of Figures 1A and 1B and are presented in Figure 2. In a qualitative way, these relative activity curves show the same general shape as

the absolute activity curves, except that the relative curves reach a plateau after a day or so.

The several different phases of these activity curves presumably indicate different processes which dominate the observed count at different times. Several brief experiments were made to see if P^{32}. In this one case, the activity curves did not show the immediate rapid rise, but simply increased smoothly during the first few hours, to reach final equilibrium values which showed less marked variation between different sites than was the case following injection of the inorganic phosphate.[5]

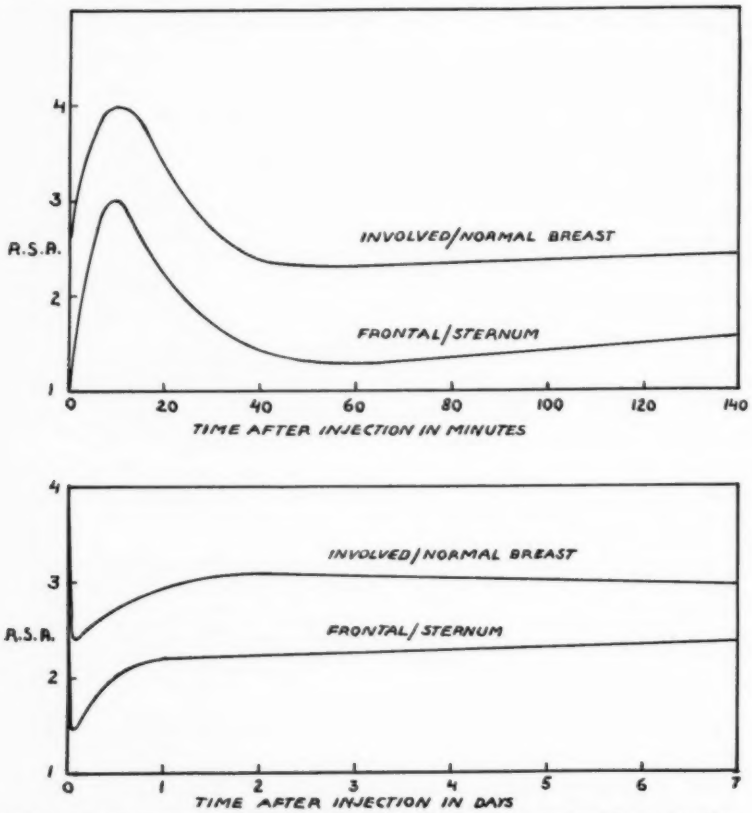

Fig. 2. Relative surface activity following injection of P^{32}, derived from the schematic activity curves of Figs. 1A and 1B.

these effects were circulatory phenomena. Patient 7 exercised during the first hour, but no significant change was produced in the counts over normal or involved areas. The hands of Patient 12 were immersed alternately in water at 37 and 10° C., but again no significant change in the readings on the hands or elsewhere were observed.

Patient 19 (polycythemia vera) was given red cells tagged with 1 millicurie

Since impaired circulation is associated with polycythemia, the character of the activity curve obtained in Patient 19 might be attributed to the polycythemia. In order to clarify this point, another patient with polycythemia vera (Patient 29) was given P^{32} as inorganic phosphate.

[5] Our measurements on this patient and Patient 30 were suggested by Dr. L. R. Wasserman, and were made simultaneously with a blood volume determination performed by him.

The typical curve with immediate rapid rise and a consistent ratio between calvarium and sternum were obtained. A third patient (Patient 30), who had diffuse metastatic carcinoma but no hematological disturbance that could affect circulatory dynamics, was given red cells tagged with 500 microcuries of P^{32}. The activity curves and relative surface counts over calvarium and sternum were similar to those obtained in Patient 19.

While these results are in no sense definitive, it is provisionally concluded, from use of this technic of injecting red cells tagged with radioactive phosphorus, that the immediate surface activity obtained after intravenous administration of radioactive phosphorus as inorganic phosphate is not due to blood in circulatory channels but reflects extravascular phosphorus. When the radioactive phosphorus is given as "tagged red cells," the phosphorus remains with the red cells within circulatory channels, and no immediate high surface activity is observed. With administration as inorganic phosphate, there is a removal of the radioactive phosphorus from the blood stream beginning within a few minutes after injection, which is greater in some tissues than in others, and greater in malignant than in normal tissues. Moreover, this rapid removal by some tissues is greater shortly after administration than subsequently. While this evidence for rapid selective uptake may well be of ultimate diagnostic importance, it has not been possible to pursue it further in the present investigation because of practical difficulties in obtaining sufficient data during the short period of observation immediately after injection.

The discussion that follows, concerning relative surface activity as a possible diagnostic tool, is limited to counts taken twenty-four hours after injection.

SURFACE ACTIVITY OF NORMAL AREAS

If surface activity is to be used as a diagnostic tool, it is necessary to know to what extent symmetrical normal areas will differ, and to what extent surface counts will vary between non-symmetrical areas of the skin. To this end, counts were taken over normal symmetrical areas. It was found that symmetrical areas show essentially equal counts, within a few per cent. In male Patient 16, counts over the thighs differed by 10 per cent, and over the nipples by 15 per cent. In female Patient 15, the difference between the nipples was 15 per cent. These appear to be the extreme variations between symmetrical normal areas.

Variations between non-symmetrical areas are much greater. The sternum was arbitrarily taken as the standard region in recording the relative surface activity of different areas, since it gave an easily identified and reproducible position. In general, the surface activity of the sternum is not too different from other areas of the body, with the exception of the calvarium, which shows about twice the activity. Examples of the surface activity relative to the sternum are these: frontal area, 2.20 ± 0.07; thigh, 0.82 ± 0.06; shin, 0.77 ± 0.04. (These numbers, and the attached standard errors, represent a mean of 8 patients.)

Evidently the variation between different areas on one patient is greater than the variation for a given area on different patients, indicating that these ratios have some real physiological significance. No simple explanation, such as the presence or absence of underlying bone, will account for the variation in these ratios. It was clear that, in the present investigation, care was necessary in the choice of control areas, either in the sense of securing strictly symmetrical control areas or carefully reproducing a chosen non-symmetrical site.

In some cases the surface count varied rapidly with small changes in position of the counter. For example, the normal breast of Patient 12 was examined in detail, and the relative surface activity with respect to the sternum varied from 1.0 to 1.3, except over the nipple, which gave the value of 2.1. Similar results were found in other patients. Thus a position near or on the nipple as a symmetrical normal

control is not reliable, since the counting rate depends critically on the precise position.

SURFACE ACTIVITY OVER SUPERFICIAL MALIGNANT TUMORS AND METASTATIC LYMPH NODES

Ten patients with obvious cutaneous or subcutaneous malignant lesions gave a count over the involved areas which was two to five times that over uninvolved control areas. These patients included 6 with primary breast carcinoma, 1 with recurrent skin nodules following radical mastectomy, 2 with generalized lymph node enlargement due to chronic lymphatic leukemia, and 1 with metastatic chest wall nodules from a primary oral carcinoma. These malignant tumors were all clinically easily detectable. Negative results were shown by Patient 16 (multiple myeloma), who presented several well defined nodules, 3 to 4 cm. in diameter in the scalp, which did not show higher surface activity than adjacent, apparently healthy scalp. This negative result was explained when it was subsequently found that these were not myeloma tissue but were cold sterile abscesses.

Studies of 8 patients with supraclavicular or axillary node metastases gave conflicting results. In 4 of the 8, the surface activity over the involved relative to the uninvolved node varied from 1.2 to 1.6. This represents, on the average, a 40 per cent higher count over the involved node. In the remaining 4, however, the surface activity over the involved node was less than that over the uninvolved, the ratio averaging 0.9, representing a 10 per cent lower count. In one of these 4 latter cases, the lymph node was removed and a radioautograph study was made after the surface measurements were completed. Positive autographs were obtained in spite of the fact that the surface count was slightly less than normal.

While the series of patients with malignant disease just described is by no means large, it has not been extended because we did not believe that there was any promise of a useful diagnostic test in the method. The superficial malignant tumors which give clear positive results by this method are relatively dramatic, but these present no diagnostic problem in any event. Where there is need of better diagnostic technics, as for lymph nodes with questionable involvement, a negative result would never be considered trustworthy, since a malignant node, even though containing considerable P^{32}, may not be sufficiently superficial to be detected.

SURFACE ACTIVITY OF MUCOUS MEMBRANES

Uncertainty as to the amount of absorption of the beta particles by the overlying tissue is not present in the case of squamous-cell carcinoma of the mucous membranes. Thus the surface counting technic may be useful for diagnostic purposes in this type of malignant disease. In particular, it might be highly advantageous for the diagnosis of carcinoma of the cervix. In this connection, there is available no symmetrical control area, so the medial aspect of the thigh was selected as a convenient control area. Measurement was also made of the surface activity of the inner surface of the lower lip, for additional information on the behavior of the mucous membranes.

The surface activities of the cervix relative to the thigh are listed in Table II. The mean of the cervix-to-thigh ratios for 5 patients with normal cervices was 3.7 (standard error of the mean = 0.4, standard error of a single determination = 0.9). The mean of the oral mucosa-to-thigh ratios for the same patients was 6.1 (standard error of the mean = 0.4, standard error of a single determination = 1.3). Presumably the former ratio reflects the higher metabolic activity of the cells in the most superficial layers of the mucous membranes as compared with the metabolic activity of the outermost cells of the skin. The increase in the surface activity of the oral compared to the cervical mucosa is presumably due to the excretion of P^{32} in saliva (23).

Patient 10, with a definite chronic cervicitis, reported as negative for carcinoma with several Papanicolaou smears and biopsies, gave a cervix-to-thigh surface activity ratio of 3.6, very close to the mean value of the normal cervices. Patients 15 and 22, with definite carcinoma of the cervix (biopsy), showed cervix-to-thigh ratios of 6.5 and 10.4, quite distinctly above the mean of the normals. Patient 23, who had completed a course of radiotherapy for carcinoma of the cervix, one month prior to this study, showed a cervix-to-thigh ratio of 2.2, somewhat below the mean of the normals. These patients were all measured with a single position of the counter on the cervix, since the size of the Geiger counter then available did not allow any sampling of different cervical areas. When measuring Patient 28, a much smaller counter was available[6] and measurement on an apparently normal part of the cervix gave the ratio 3.6, while measurement on an untreated region of carcinoma (biopsy) gave a ratio of 12.6, which was much the highest ratio observed. About three months after radiotherapy, this ratio had dropped to 5.6. Patient 15 was observed again fourteen months after completion of radiotherapy. The cervix-to-thigh ratio had dropped to 3.7 from 6.5.

While this short list of patients is in no sense definitive, it indicates the possibility that surface counting may provide a simple and reliable diagnostic method for carcinoma of the cervix. A large series of cases will have to be tested before this possibility is established.

SUMMARY

1. Thirty patients with various malignant diseases were studied, by means of an end-window Geiger-Müller counter, for beta particle surface activity following oral or intravenous administration of radioactive phosphorus.

2. Surface activity appears at once, reaches a maximum between three and fifty minutes after intravenous administration, and decreases approximately exponentially after twenty-four hours. Schematic surface activity curves for various areas are presented.

3. The extreme variation in surface activity between symmetrical normal areas is about 15 per cent, while the activity over the calvarium and the nipples is characteristically about 100 per cent higher than over other areas.

4. Over ulcerated and non-ulcerated cutaneous malignant disease, the surface activity may be two to five times that in normal areas. This differential appears within a few minutes after administration.

5. Surface activity over lymph node metastases was in some patients higher than, and in other patients not appreciably different from, the control areas.

6. Surface activity of the cervix was three to four times that of the thigh in normal patients, but was at least six times that of the thigh in 3 cases of carcinoma of the cervix. This ratio was reduced after radiotherapy.

CONCLUSIONS

It is concluded that the measurement of surface beta activity following administration of inorganic P^{32} does not appear to be necessary for the diagnosis of cutaneous malignant lesions, nor reliable for the diagnosis of subcutaneous lesions or metastatic lymph nodes. It may, be useful in carcinoma of the mucous membranes, as a diagnostic technic or for evaluation of effectiveness of therapy.

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[6] See footnote on page 860.

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SUMARIO

Actividad Superficial Consecutiva a la Administración de Fósforo Radioactivo

Treinta sujetos con varias afecciones malignas fueron estudiados, por medio de un contador fenestrado de Geiger-Müller, con respecto a la actividad superficial en partículas beta, consecutivamente a la administración oral o endovenosa de fósforo radioactivo.

La mayor variación de la actividad superficial entre zonas normales simétricas es aproximadamente de 15 por ciento, en tanto que la actividad sobre el calvario y los pezones es típicamente aproximadamente 100 por ciento mayor que en otras zonas.

Sobre neoplasias malignas ulceradas o no en la piel, la actividad superficial puede ser el doble o el quíntuplo que en zonas normales.

La actividad superficial sobre metástasis ganglionares fué en algunos enfermos mayor, y en otros no apreciablemente distinta, de la observada en las zonas testigos.

La actividad superficial del cuello uterino fué del triple al cuádruple de la del muslo en las enfermas normales, pero por lo menos el séxtuplo en tres casos de carcinoma cervical. Esta proporción descendió después de la radioterapia.

Dedúcese que la medición de la actividad superficial beta consecutivamente a la administración de P^{32} inorgánico no parece ser necesaria para el diagnóstico de lesiones malignas cutáneas ni fidedigna para el diagnóstico de lesiones subcutáneas o de metástasis ganglionares. No obstante, puede resultar útil en el carcinoma de las mucosas, y como técnica de diagnóstico o para justipreciar la efectidad de la terapéutica.

An Evaluation of the Radioiodine Concentration Test in the Study of Thyroid Disease[1]

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With the Technical Assistance of

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THE AVIDITY OF the thyroid gland for the essential thyroid hormone precursor iodine is a measure of thyroid function and can be gauged by means of the radioactive iodine tracer technic. Since the original studies of Hamilton and Soley (1) and of Hertz, Roberts, and Evans (2), an extensive literature has accumulated, recording the experiences of various workers with radioactive iodine. This has been well documented by others (3) and will not be reviewed here. The purpose of the study to be reported was to determine the applicability of radioactive iodine tracer tests to the routine hospital evaluation of thyroid disease, and to compare their diagnostic accuracy with both clinical evaluation and more familiar laboratory procedures, particularly the estimation of the basal metabolic rate (BMR).

METHODS

One hundred microcuries of I^{131} (obtained from the Clinton Laboratories, Oak Ridge, Tenn.) in 50 c.c. of water, without added carrier iodine, were administered orally to patients one hour after a breakfast of toast and coffee, or in the fasting state, followed by 100 c.c. of water. Early in the course of the studies, counts of gamma radiation were made for five-minute periods at varying intervals, but later were limited to a five- or six-hour, a twenty-four-hour, and a forty-eight-hour reading. A Geiger-Müller counter, 15 cm. long, was centered over the thyroid isthmus (17 cm. above the skin). Background counts taken from the upper thigh were subtracted from the final reading, and the per cent uptake of the administered dose was calculated from a calibration curve prepared for each lot of I^{131}. Errors of single determinations were ascertained by taking three successive five-minute readings in thirty-five patients. The average difference where the I^{131} uptake was below 10 per cent was 0.85 per cent; in the 10 to 35 per cent range, 1.03 per cent; above the normal range, 2.49 per cent. The average difference for the entire group was 1.39 per cent.

STUDIES AND RESULTS

One hundred and fifty-nine patients were studied. They were classified (*vide infra*) on the basis of clinical evaluation and various laboratory studies but without reference to the results of the radioiodine test.

I. "Normal" Control Group

(*A*) *Normal Subjects:* This group comprised 15 normal subjects, 5 patients with mild benign essential hypertension, and 14 cases of non-endocrine obesity.

(*B*) *Endocrine Disease Without Thyroid Dysfunction:* Twenty-six patients, representing a group of endocrinopathic problems without thyroid dysfunction, were observed for periods of eight to thirty-six months. This heterogeneous collection included acromegaly, idiopathic hypoparathyroidism, dwarfism, virilism, various menstrual disorders, infertility, hypogonadism, diabetes mellitus, and others.

(*C*) *Euthyroid Subjects:* This group consisted of 55 patients who were referred to the endocrine clinic for evaluation of suspected, but subsequently disproved, thyroid disease. Long periods of observation were sometimes necessary before the

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TABLE I: DISTRIBUTION OF TWENTY-FOUR-HOUR I^{131} UPTAKE IN 159 SUBJECTS

Group	Per Cent Uptake of Administered I^{131} in Twenty-four Hours											Total Cases
	0–4	5–9	10–14	15–19	20–29	30–34	35–39	40–44	45–49	50–59	60–69	70–79	80–89	
I. "Normal" Controls														
A. Normal			4	5	4	2								15
Essential hypertension			2		2	1								5
Obesity	1	3	4	1	5									14
B. Endocrinopathy		1	6	4	8	4	3							26
C. Suspected hyperthyroidism		2	4	3	10	1	1							21
Suspected hypothyroidism		5	2		1	2	3	2						15
Non-toxic nodular goiter		3	1	1	3	1	1	1						11
Smooth goiter			2	2	3		1							8
II. Hyperthyroidism							2	4	1	5	4	5	4	25
Toxic nodular goiter							1	2		2	1	1		(7)
Toxic diffuse goiter							1	2	1	3	3	4	4	(18)
III. Hypothyroidism	8	10	1											19
Myxedema	2	2												(4)
I, II, and III														159

TABLE II: RANGE, MEAN, AND STANDARD DEVIATION OF I^{131} UPTAKE OF NORMAL SUBJECTS AND OF PATIENTS WITH THYROID DISEASE

	Range at 24 Hours	Mean Uptake of I^{131}			Standard Deviations		
		At 5–6 Hours	At 24 Hours	At 48 Hours	At 5–6 Hours	At 24 Hours	At 48 Hours
	%	%	%	%	%	%	%
Hyperthyroid	35–82	58.1	59.9	53.5	16.75	15.27	14.87
Combined "normal"	3.5–44	15.8	21.1	19.5	7.34	9.87	10.18
A. Normal		13.2	18.3	17.0	6.25	8.38	9.08
B. Non-thyroid endocrine		16.9	22.2	21.1	6.82	8.82	9.26
C. Euthyroid		16.8	22.2	20.5	7.87	10.98	11.18
Hypothyroid	1–10	8.4	5.0	3.9	2.09	2.04	3.03

correct diagnosis was established. The patients were divided into four subgroups, each of which was evaluated separately (Table I).

No statistical difference (4) was found between the twenty-four-hour means of groups A, B, and C (Table II), so that they were considered as a single "normal" control group for comparison with hyperthyroid and hypothyroid patients. The distribution of the I^{131} uptake for normal subjects is shown in Table I, and the mean and the standard deviation in Table II. The twenty-four-hour mean uptake was 21.1 per cent, the range 3.5 to 44 per cent, and the standard deviation 9.87 per cent. It may therefore be expected that 95 per cent of any similar group of euthyroid subjects seen in an endocrine clinic for thyroid evaluation will fall within a range of 1.4 to 40.8 per cent (*i.e.*, plus or minus twice the standard deviation).

The test was repeated in 6 euthyroid subjects at varying intervals. Tracers showed the closest agreement when the interval was less than four weeks. This has been noted by Stanley and Astwood (5) in a larger series of patients.

II. Hyperthyroidism

Twenty-five thyrotoxic patients were evaluated, 18 with diffuse toxic goiters and 7 with toxic nodular goiters. The maximum mean uptake, 59.9 per cent, occurred at twenty-four hours, the range was 35 to 82 per cent, and the standard deviation 15.27 per cent (Tables I and II). The range for 95 per cent of any similar group of hyperthyroid subjects would therefore be expected to be 29.4 to 90.4 per cent.

TABLE III: VALUES OF "*t*" TO DETERMINE SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS IN TABLE II

	Hyperthyroid	Euthyroid	Endocrine Disorders	Normal	Hypothyroid
5–6 hours					
Euthyroid	14.75**				
Endocrine disorders	10.99**	0.05			
Normal	13.61**	2.14*	2.06*		
Hypothyroid	12.49**	4.44**	5.09**	3.14**	
24 hours					
Hyperthyroid					
Euthyroid	12.48**				
Endocrine disorders	10.83**	0.00			
Normal	13.42**	1.77	1.75		
Hypothyroid	15.51**	6.79**	8.31**	6.79**	
48 hours					
Hyperthyroid					
Euthyroid	9.94**				
Endocrine disorders	8.69**	0.22			
Normal	11.03**	1.46	1.64		
Hypothyroid	14.21**	6.34**	7.75**	6.06**	

t—0.00 to 1.96 (no significant difference between means).
*t**—1.96 to 2.58 (significant difference between means).
*t***—2.58 and over (very significant difference between means).

In 5 patients, tests were repeated after several months of methyl-thiouracil therapy, and in all there was a significant reduction in iodine uptake. Tracer studies were repeated before treatment was instituted in 3 thyrotoxic patients. One patient, who showed an initial twenty-four-hour uptake of 81 per cent, accumulated only 51.5 per cent two months later. During this period she was receiving large doses of vitamin A as part of a study of its possible antithyroid action (6). Clinical benefit did not parallel this reduction in iodine concentration. A second subject, similarly treated, showed a reduction from 54 to 48 per cent, a change of questionable significance. A third hyperthyroid patient showed consistent high uptakes in three tests done four weeks apart. Relapse of thyrotoxicosis following cessation of antithyroid therapy in 2 patients was paralleled by a marked increase in avidity of the thyroid for I^{131}.

III. Hypothyroidism

Nineteen hypothyroid patients were studied. The diagnosis was established only after periods of observation ranging from three months to over two years. All showed an unequivocal clinical and laboratory response to thyroid therapy, with relapse when treatment was stopped. Four of the group were classical cases of myxedema, and an additional case was thought to be on the basis of hypopituitarism. The basal metabolism rate ranged from −13 to −55 per cent, and the serum cholesterols from 165 to 616 mg./100 c.c. The maximum mean uptake occurred at five to six hours (8.4 per cent), the mean at twenty-four hours being 5.0 per cent (Tables I and II). In any similar hypothyroid group one may expect 95 per cent to fall within a range of 0.92 to 9.08 per cent.

TABLE IV: CALCULATED PERCENTAGE OF CASES EXPECTED TO FALL WITHIN CERTAIN LIMITS ON THE BASIS OF THESE DATA

	24-Hour I^{131} Uptake		
	0–9%	10–34%	35% and over
Hyperthyrodism	0.05	5.16	94.79
Normal	13.14	78.93	7.93
Hypothyroidism	99.29	0.71	0.00

The test was repeated in 7 untreated hypothyroid patients at varying intervals. In 5 patients the second tracing confirmed the results of the first. Two patients who received desiccated thyroid for eighteen months showed a sustained clinical remission after cessation of treatment and the previously low I^{131} uptake became normal.

Comparison of the "Normal," Hyperthyroid, and Hypothyroid Groups

It is evident that some overlap exists between the "normal" group and the pa-

tients with thyroid disease (Table I). Twelve of the 115 normal subjects (10.4 per cent) and 6 of 25 hyperthyroid patients (24 per cent) appeared in the uptake range from 35 to 44 per cent. None of the thyrotoxic patients showed uptakes below 35 per cent. One of 19 hypothyroid patients (5 per cent) was in the normal range, but this patient concentrated exactly 10 per cent; 15 of 115 normal subjects (13 per cent) accumulated less than 10 per cent. Distribution curves were calculated for the three groups at five to six, twenty-four, and forty-eight hours. The points of overlap were used to define the optimum limits of normal radioiodine uptake. It was found that a range of 10 to 35 per cent most nearly satisfied the requirements of the test. However, 23 per cent of normal patients were outside these limits, 13 per cent below and 10 per cent above. In Table III, the differences between the means of all groups are shown to be highly significant.

Comparison of Readings for Five to Six, Twenty-four and Forty-eight Hours

Five thyrotoxic patients showed five-to-six-hour readings higher than the twenty-four-hour determinations, but in each instance the twenty-four-hour figure was above the upper limits of normal, as shown below:

I^{131} PER CENT UPTAKE

Patient	5–6 Hours	24 Hours
J. P.	64	43*
J. G.	45.5	42
M. P.	63	53
M. We.	42	35*
M. Wa.	45	39*

* See text.

The five-to-six-hour reading was valuable in establishing the diagnosis in the 3 cases marked with asterisks, where the twenty-four-hour determination, though above the upper limit of normal, was still within the doubtful range. The forty-eight-hour determination was either not significantly different from the twenty-four-hour uptake or was somewhat lower.

The five-to-six-hour reading was higher than the twenty-four-hour in 17 of 19 hypothyroid patients, and was 10 per cent or greater in 4 cases where the twenty-four-hour reading was appreciably below 10 per cent. In only one instance was the twenty-four-hour reading higher than that at five to six hours. The forty-eight-hour uptake was lower than the twenty-four-hour in most of the patients but did not prove to be of sufficient diagnostic importance to warrant the added inconvenience of requiring a patient to return for a third day.

The five-to-six-hour and forty-eight-hour uptakes were usually lower in the "normal group" than the twenty-four-hour determination. The difference between the twenty-four-hour and the forty-eight-hour readings was not of sufficient diagnostic importance to warrant carrying out the latter.

In effect, a twenty-four-hour determination of I^{131} uptake by the thyroid gland is adequate for routine screening purposes. Where the diagnosis of hyperthyroidism was suspected, the five-to-six-hour determination occasionally proved to be of some additional value.

Influence of Sex and Age

Perlmutter and Riggs (7) reported a decreased iodine uptake in the aged, and after puberty a greater accumulation in the female than in the male. No significant differences were found in this series. Only 15 of the normal group, however, were less than twenty years of age and 11 were over sixty years old, so that the extremes were not well represented.

Comparison of I^{131} Uptake with Basal Metabolism Rate

A comparison of the I^{131} uptake and the basal metabolism rate was possible in 21 hyperthyroid, 17 hypothyroid, and 87 normal patients. The normal limits for the basal metabolism rate were considered to be -10 to $+15$ per cent, although -15 to $+15$ per cent would not have altered the statistics. Basal metabolism figures

represent the average of two or more reliable determinations.[2]

All of the hyperthyroid and hypothyroid patients were detected by both tests. The two procedures, therefore, compared favorably in instances of frank thyroid dysfunction. A substantial divergence became evident when they were compared in normal patients (Table V), the radioiodine test proving more than twice as reliable as the basal metabolism rate. The coefficients of correlation for the normal, hyperthyroid, and hypothyroid patients separately are shown in Table V.

TABLE V: COMPARISON OF I^{131} UPTAKE AT TWENTY-FOUR HOURS WITH THE BASAL METABOLISM RATE IN 87 NORMAL PATIENTS

	Per Cent of Normal Patients Having Readings		
	Within Hyperthyroid Range	Within Hypothyroid Range	Total Outside Normal Range
I^{131}	(12) 14%	(10) 11%	(22) 25%
BMR	(17) 20%	(30) 34%	(47) 54%

Coefficient of Correlation Between I^{131} Uptake and BMR	
Hyperthyroids	−0.38
Normal	−0.25
Hypothyroids	−0.20
TOTAL	+0.75

DISCUSSION

The data presented corroborate the findings of others regarding the differences in the uptake of radioactive iodine by the thyroid gland of normal, hyperthyroid, and hypothyroid subjects. The degree of overlap demonstrates that, despite the use of a diagnostic technic that entails the direct measurement of the iodine-concentrating capacity of the gland, a doubtful range exists with this as with all other laboratory tests. This may be interpreted in two ways: (*a*) that measuring iodine-concentrating capacity is not a direct measure of thyroid hormone formation and thus may not accurately depict the true activity of the thyroid, (*b*) that, as Quimby and McCune suggest (8), hyperthyroidism and hypothyroidism are relative states that show variability of degree.

Previous ingestion of iodine is known to diminish the uptake of radioiodine, and this factor may be operative in certain patients. Though the data are not shown, potassium thiocyanate was administered to several patients with less than 10 per cent uptake in an attempt to cause a discharge of thyroid iodide preceding a repetition of the test (9). No important difference has so far been noted, but this work is being continued and will be reported elsewhere.

In Table VI, the findings of Werner, Quimby, and Schmidt (10) are compared to this study. Despite certain minor differences in technic, results are quite similar and reveal no discrepancies requiring discussion. On the basis of statistical probabilities, it was predicted that 5 per cent of thyrotoxic subjects would accumulate less than 35 per cent of the administered dose of I^{131}. Werner *et al.*, in their much larger series of hyperthyroid patients, did in fact find 6 per cent of 97 patients falling in the range below 35 per cent.

The diagnostic accuracy of the basal metabolic rate was paralleled by this test in patients with disordered thyroid function. It proved misleading, however, in more than twice as many cases as did the radioiodine test in patients with normal thyroid function. This objective laboratory technic eliminates most of the factors which adversely affect the accuracy of the basal metabolic rate in the absence of thyroid disease, and is therefore an important diagnostic aid in such instances.

The diagnostic value of the I^{131} uptake was demonstrated in numerous instances. For example, there were 12 patients with elevated basal metabolic rates ranging from +23 to +63 per cent in whom hyperthyroidism was suspected, but in whom the twenty-four-hour I^{131} uptake was within the normal range in 10 and 36 per cent in the remaining two. The absence of thyroid toxicity was finally established after periods of observation, therapeutic trials with iodine and/or antithyroid drugs, or response to adequate sedation. In an-

[2] Many of these determinations were performed on an outpatient basis.

TABLE VI: COMPARISON OF PRESENT STUDY WITH THAT OF WERNER *et al.*

	Werner *et al.*	Philadelphia General Hospital
Dose	40–100 microcuries	100 microcuries
Preparation of patient	None	Fasting or light breakfast
Distance of Geiger counter from thyroid isthmus	15 cm.	17 cm.
Time of readings	24 hours	5–6, 24, and 48 hours
Euthyroid patients	57	115
Selection	Ward and clinic patients, without endocrine disorders	See Table I
Mean I^{131} uptake	...	21.1%
Range of uptake	7–49%	3.5 to 44%
Standard deviation	...	9.87%
Under 35% uptake	91%	76%
Hyperthyroid patients	97	25
Above 35%	94%	100%
Above 40%	89%	92%
Hypothyroid patients	3	20
Results	0–9	Mean 5.0% Range 1–10% S. D. 2.04

other 12 subjects certain clinical phenomena plus low basal metabolism rates ranging from −15 to −34 per cent suggested hypothyroidism. In 9 the radioiodine uptake was within normal limits and its diagnostic accuracy was subsequently confirmed. In the 3 remaining patients, despite the coexistence of hypometabolism and subnormal I^{131} uptake, the absence of hypothyroidism seemed likely after prolonged therapeutic trials with thyroid and various placebos. The finding of subnormal uptakes in 13 per cent of our normal subjects further demonstrates the need for clinical judgment with this diagnostic laboratory procedure as with all others.

The comparison of the five- or six-hour, the twenty-four-hour, and the forty-eight-hour readings demonstrated that a single twenty-four-hour determination was adequate to establish the diagnosis in almost every case. The inconvenience to the patient and the added expense to the hospital required by the five- and forty-eight-hour readings do not justify their inclusion in routine diagnostic studies.

The data presented demonstrate that a test involving the measurement of the twenty-four-hour uptake of I^{131} by the thyroid gland is a useful addition to the hospital diagnostic armamentarium, possessing certain advantages over the basal metabolic rate determination but, despite its apparent physiologic specificity, being merely another laboratory technic requiring interpretation in conjunction with the clinical picture.

SUMMARY

A test measuring the ability of the thyroid gland to concentrate I^{131} was evaluated for routine use in the diagnosis of thyroid disease.

The normal range was established between the the limits of 10 and 35 per cent of the administered dose.

Fifteen (13 per cent) of 115 "normal" subjects were below and 12 (10 per cent) were above these normal limits.

All of the 25 hyperthyroid patients concentrated 35 per cent or more and all of the 19 hypothyroid patients concentrated 10 per cent or less.

The radioiodine test was found to be more than twice as accurate as the basal metabolism rate in the recognition of normal thyroid function and was equal in the diagnosis of thyroid disease.

The statistical possibilities of the use of this test are discussed.

A single twenty-four-hour reading after the administration of I^{131} was found to be adequate for routine diagnostic studies.

NOTE: The authors wish to thank Mrs. Barbara Sigmund, Statistician of the Philadelphia General Hospital, for the statistical analysis.

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SUMARIO

Valuación de la Prueba de la Concentración de Radioyodo en el Estudio de las Afecciones Tiroideas

Estos estudios tenían por fin averiguar la exactitud diagnóstica de las pruebas de concentración del yodo radioactivo, comparadas con la justipreciación clínica y las determinaciones del metabolismo basal en las enfermedades del tiroides.

El yodo radioactivo (I^{131}) fué administrado por vía oral (100 microcuries en 50 c. c. de agua), haciéndose numeraciones a plazos de cinco o seis, veinticuatro y cuarenta y ocho horas. Hubo 149 personas estudiadas, representando: (1) un grupo llamado "normal," que comprendía enfermos con obesidad, hipertensión esencial, varias endocrinopatías sin distiroidia y supuesta afección tiroidea, luego confutada; (2) un grupo hipertiroideo; (3) un grupo hipotiroideo.

La escala normal quedó establecida entre los límites de 10 y 35 por ciento de la dosis administrada. Quince (13 por ciento) de 115 sujetos "normales" se hallaban por debajo y 12 (10 por ciento) por encima de dichos límites normales. Todos los 25 hipertiroideos concentraron 35 por ciento o más y todos los 19 hipotiroideos 10 por ciento o menos.

La prueba del radio-yodo mostró una exactitud más del doble que la del metabolismo normal en el reconocimiento de la función tiroidea normal e igual a la de la última en el diagnóstico de enfermedad tiroidea.

Discútense las posibilidades estadísticas del empleo de esta prueba.

Una sola lectura a las 24 horas de la administración de I^{131} resultó ser adecuada para los habituales estudios diagnósticos.

Pulmonary Artery Obstruction

Report of a Case with Angiocardiographic Demonstration[1]

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THE PURPOSE OF this paper is to report a case of incomplete obstruction of the left pulmonary artery demonstrated during life by angiocardiography.

Reviews of the literature pertaining to thrombosis of the main pulmonary artery and its right and left branches were made by Kampmeier (1) in 1934 and by Savacool and Charr (2) in 1941. The latter authors summarized 100 reported cases, including their own, and found the preponderant site to be the right pulmonary artery. In 46 per cent of the cases, the thrombosis was associated with parenchymal pulmonary disease. Pathological conditions which were associated with the thrombosis were tuberculosis, mitral stenosis, aortic valvular disease, congenital heart disease, and embolism from the peripheral veins. Anthracosilicosis, emphysema, fibrosis, lung abscess, jaundice, possible syphilis of the pulmonary artery, chronic purulent bronchitis, pulmonary atherosclerosis, bronchiectasis, bronchopneumonia, empyema, and pulmonary carcinoma were among other diseases present. Tuberculosis has been mentioned by several writers as a frequent cause of pulmonary artery occlusion (3–5).

The predominant clinical findings in the reported cases were progressive dyspnea, cough, chest pain, hemoptysis, restlessness, exophthalmos, low pulse pressure with thready pulse, and edema of the lower extremities. The onset may be acute, but occasionally no symptoms are present until evidence of right heart failure ensues.

In many of the cases collected by Savacool and Charr there was evidence of right heart enlargement, which we feel indicated the presence of cor pulmonale. This may be a result of the existing pulmonary disease but may have occurred as a consequence of pulmonary artery occlusion. Although most of the cases of pulmonary artery occlusion were found after death, the condition is not incompatible with life, when either the right or the left or even the main pulmonary artery is involved (Desclin and Regnier, 6). The diagnosis, therefore, is an important clinical consideration.

The roentgenographic study of the pulmonary circulation and obstruction of the pulmonary artery or its branches includes the use of plain films, fluoroscopy, and opaque studies. The changes which are demonstrable by these methods will be described in the discussion.

CASE REPORT

T. B., a 54-year-old single white female, entered the clinic complaining of soreness through her stomach and bowels for three and a half years. She had spells of vomiting upon arising in the morning, but this did not seem to be influenced by what she ate. There had been no melena, chills, fever, or colic. Associated complaints were bloating, belching, flatus, and irregular bowel habits, constipation alternating with frequent loose stools.

Important points in the past history included: (1) close contact with a patient who succumbed to tuberculosis in 1916; (2) a tonsillectomy in 1918, at which time the procedure had to be interrupted for the application of a pulmotor; (3) in 1919 attacks of nausea and vomiting after meals, immediately or at varying intervals up to several hours; (4) a heavy "cold" in 1920, with sputum containing acid-fast bacilli; (5) a three-year rest period (1920–1923); (6) twenty-five years of steady employment as a cigar maker.

The patient was a small woman, height 59-1/2 inches, weight 95-1/2 pounds. Her blood pressure was 135/98, pulse 112, and temperature 98.4° F. There was a definite flattening of the left thoracic wall, both anteriorly and posteriorly, with rather marked limitation of motion over the left side of the chest, diminished breath sounds, and dry crackling râles. The heart was shifted to the left. P-2 was greater than A-2.

The vital capacity was 73 per cent (2.2 liters). A

[1] From the Caylor-Nickel Clinic, Bluffton, Ind. Accepted for publication in October 1950.

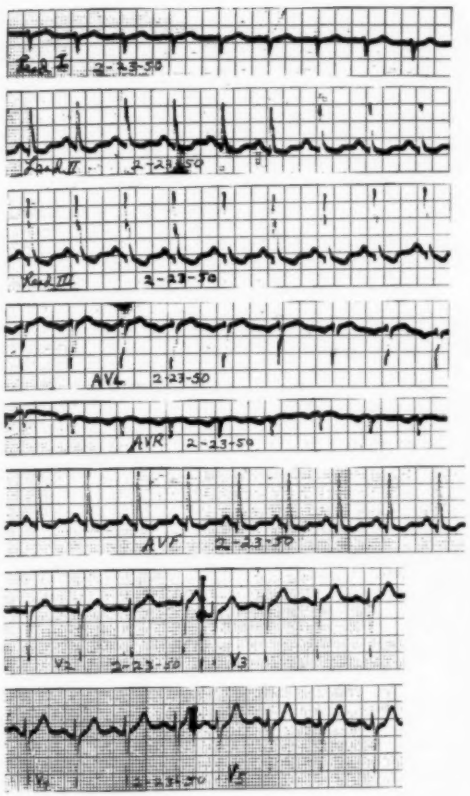

Fig. 1. Electrocardiogram showing changes compatible with cor pulmonale.

complete blood count, Mazzini test, barium meal and enema studies, and cholecystograms revealed no abnormalities. The basal metabolic rate was +14 per cent, and the erythrocyte sedimentation rate was 21 mm. in one hour.

The electrocardiogram (Fig. 1) indicates a sinus tachycardia, rate 105. The PR interval is 0.18 second, and QRS interval 0.08 second. There is a deep S-1 and a high voltage slurred R-3, making the angle of electrical axis +100°. ST-2 and ST-3 are markedly depressed and STV-5 and STAVF slightly depressed. T-2 and TAVF are diphasic − +, TAVR diphasic + −, and T-3 is inverted. These electrocardiographic findings are compatible with cor pulmonale.

Postero-anterior films of the chest (Fig. 2) were obtained on Feb. 23, 1950, showing the heart and mediastinum to be shifted to the left to a moderate degree. The left upper lobe was apparently atelectatic, with calcific and productive changes indicating that this atelectasis was probably secondary to tuberculosis. Calcific and productive changes were also present in the right upper lung fields. The left costophrenic sinus was obliterated by pleural thickening. The markings in the right lung were somewhat prominent. The right hilus was within normal limits, while the left hilar shadow was apparently small and retracted in an upward direction. Pulmonary markings on the left were practically absent. The left lung field appeared to be hyperaerated.

These changes were considered very suggestive of an obstruction or stenosis of the pulmonary artery secondary to the tuberculous process, and angiocardiographic studies were advised.

Postero-anterior examination of the chest in inspiration and expiration, Feb. 24, revealed no further

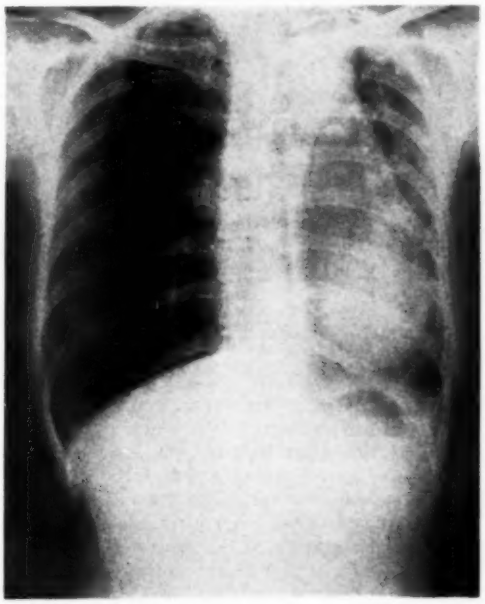

Fig. 2. Postero-anterior roentgenogram of the chest. The left upper lobe is contracted as a result of tuberculosis. The heart and mediastinum are shifted to the left. The left hilus is elevated. Vascular markings on the left are inconspicuous as compared to the right. These changes are suggestive of left pulmonary artery occlusion.

shift of the mediastinum with respiration. *Fluoroscopy* was also done and no evidence of paradoxical motion of the diaphragm was present. A *left lateral view* of the chest revealed the left upper lobe to be atelectatic due to the tuberculous process. No further change was demonstrated.

Angiocardiographic studies (Figs. 3-5) were made on Feb. 28. The right ventricle and auricle were well opacified. There was some enlargement of the outflow tract of the right ventricle. The pulmonary artery was considerably displaced, along with the heart, toward the left. The right pulmonary artery and the main pulmonary artery were dilated. The left pulmonary artery ended abruptly about three-quarters of an inch distal to the bifurcation of the

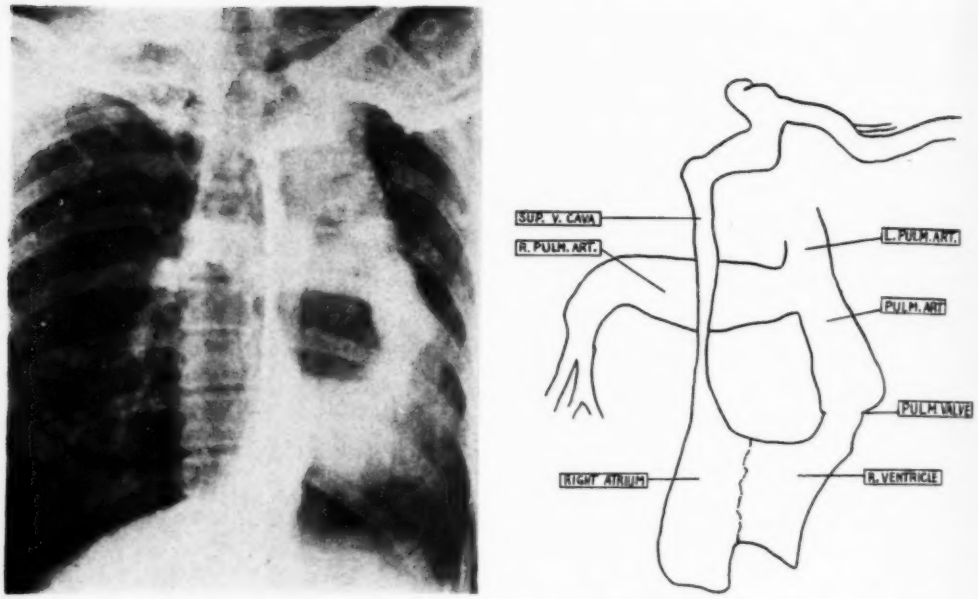

Fig. 3. Angiocardiogram. A multiple cassette changer was used, taking six films in eight seconds. Diodrast (70 per cent) was injected into the left median cubital vein. The film and drawing show dye in the right heart and some opacification of the pulmonary artery. The outflow tract of the right ventricle shows some elongation. The right ventricle is in systole.

pulmonary artery. This was apparently the site of an incomplete obstruction of the artery, or a complete occlusion which had been canalized. The left pulmonary artery and the left hilus were considerably elevated. Very little dye was seen in the left lung distal to the point of obstruction. Some vascular markings were demonstrated, but these were very few. The markings in the right lung appeared to be prominent and there was some dilatation of the vessels, suggesting an increased amount of blood in this lung.

These changes indicated incomplete obstruction of the left pulmonary artery. The left ventricle was adequately demonstrated and did not appear to be enlarged. The aorta appeared to be slightly dilated and there were considerable torsion and displacement of the heart toward the left. The aorta was also displaced and twisted. Many of the branches of the aorta were adequately filled, including the innominate, carotids, and also the subclavian. The subclavian vein was displaced with the mediastinum, and showed a considerable degree of tortuosity on the left side.

DISCUSSION

The case reported illustrates several important points in the diagnosis of pulmonary artery occlusion. The diagnosis can be suspected on the plain film because of diminished vascularity of a lung or a portion of a lung. This sign was described by Westermark (7). It is an important clue, particularly in the presence of existing pulmonary disease. Furthermore, a displaced hilar shadow due to pulmonary disease may indicate torsion of the pulmonary artery. The plain film may also show changes in the heart suggesting a cor pulmonale. Prominence of the pulmonary artery on the uninvolved side and of the pulmonary artery portion of the cardiac contour may be found in this condition. Pulmonary angiography demonstrates findings which are pathognomonic of arterial occlusion. The opacified pulmonary artery is usually dilated proximal to the point of occlusion or partial obstruction. The actual site of the stenosis may be demonstrated by this method. In addition, there is frequently enlargement of the outflow tract of the right ventricle. The lung fields distal to the point of obstruction show a diminished vascularity. Many excellent papers have been written on the angiographic aspects of pulmonary disease (8–10). In 1938, Steinberg and Robb (11)

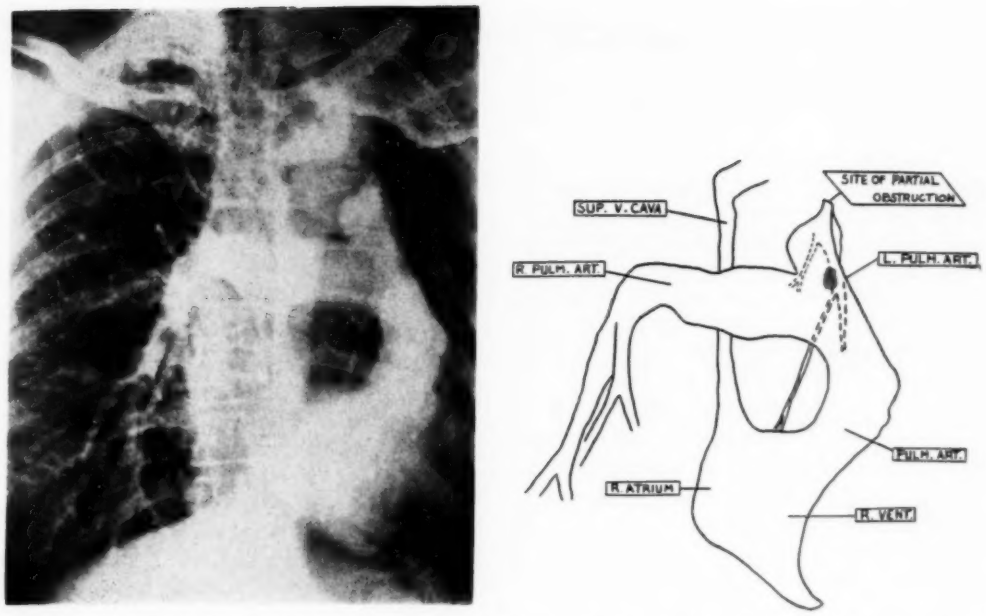

Fig. 4. Angiocardiogram. The pulmonary artery is well opacified, and is seen to be dilated. The right pulmonary artery is dilated. The obstruction in the left pulmonary artery is demonstrated. The gradual narrowing suggests canalization of a thrombosis that had been completely obstructing. Vascular markings are prominent in the right lung, but are very infrequent in the left lung. There are marked displacement and torsion of the heart and pulmonary artery.

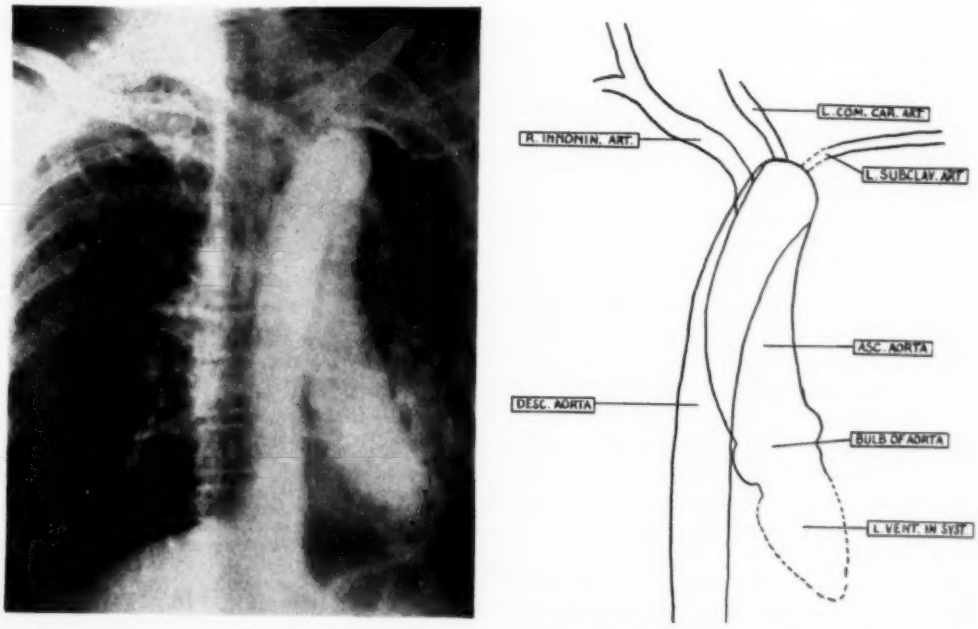

Fig. 5. Angiocardiogram. The dye now fills the left atrium, left ventricle, and aorta. The displacement and torsion of the heart and aorta are well demonstrated.

reported three cases in which pulmonary artery obstruction was demonstrated by angiopneumography.

Pulmonary artery obstruction is not incompatible with life. The importance of making a definite diagnosis is therefore evident. Although sudden death may result from the effects of acute cor pulmonale, the patient may live for weeks or years with this condition. For this reason, the management of the acute attack is doubly important. It is similar to the management of acute coronary occlusion. The patient must be put at absolute rest, inclined at the angle which best aids his respiratory movements. All patients should be placed in an oxygen tent. Their anxiety and pain should be allayed with morphine, 1/4 gr. (0.015 gm.) subcutaneously, or demerol, 1-1/2 gr. (100 mg.) intramuscularly. We feel that aminophyllin, 3-3/4 to 7-1/2 gr. administered intravenously, very slowly, is beneficial, decreasing pulmonary arterial vasospasm and therefore pulmonary hypertension. Where right ventricular failure seems imminent, the patient should be digitalized. The question of venesection for the increased pulmonary pressure and intra-arterial transfusion for the lowered systemic pressure is for the clinician to decide in the individual case; we feel that these are heroic measures.

The importance of pulmonary angiography in the diagnosis of this condition should be remembered. The frequency of tuberculosis associated with pulmonary artery obstruction suggests that arteriography should be used more often in tuberculous patients who show either a diminished vascularity of one lung as compared to the other, or significant displacement of the corresponding hilar shadow, or both. Angiography would be particularly helpful in differentiating pulmonary artery occlusion from other conditions which might cause diminished vascularity of a lung or part of a lung. Westermark, in discussing the differential diagnosis from a radiological standpoint, states that bronchostenosis with a valve effect can produce "wedge-shaped areas in the lung with a definite clearing up as a result of emphysema and anemia." He also mentions a sudden interruption of the vascular pattern in normal lungs owing to the fact that the vessels take another turn after dividing. Compensatory emphysema and localized emphysema must also be considered in the differential diagnosis.

SUMMARY

A case of acquired incomplete occlusion of the pulmonary artery has been presented, and the roentgen changes on the flat film and on angiocardiography have been described and discussed.

The wider use of angiopneumography for suspected pulmonary artery stenosis is suggested. It is indicated in the presence of diminished vascularity of a portion of the lung associated with pulmonary disease and/or displacement of the hilar shadow. It should prove of particular value in tuberculosis and many other pulmonary conditions.

A brief discussion of cor pulmonale and illustrations of electrocardiographic findings have been presented.

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SUMARIO

Oclusión de la Arteria Pulmonar. Presentación de un Caso Descubierto por la Angiocardiographía

El caso descrito es de oclusión incompleta adquirida de la arteria pulmonar izquierda, revelado por la angiocardiografía. Los hallazgos en las radiografías corrientes que denotan posible oclusión de la arteria pulmonar consisten en hipovascularidad de un pulmón o de parte del mismo, desplazamiento de la imagen hiliar y alteraciones cardíacas indicativas de cor pulmonale.

Los hallazgos angiográficos son patognomónicos. La arteria opaca suele mostrar dilatación proximal al sitio de la obstrucción, y cabe observar el sitio real de la estenosis. Además, se halla frecuentemente hipertrofiado el trayecto de salida del ventrículo derecho.

Propónese un empleo más amplio de la angioneumografía cuando se sospecha arterioestenosis pulmonar. Está indicado dicho procedimiento en presencia de hipovascularidad de una porción del pulmón asociada a neumopatía y/o desplazamiento de la sombra hiliar, debiendo resultar en particular útil en los enfermos con tuberculosis u otras lesiones pulmonares.

Symphalangism and Related Fusions of Tarsal Bones[1]

CAPT. FRANK H. AUSTIN, M. C., U. S. A

THE CONGENITAL absence or fusion of interphalangeal joints was named symphalangism by Dr. Harvey Cushing in 1916 (1). This article adds a further case to the American literature, with associated fusions of the tarsal bones.

A twenty-year-old soldier was examined because of pain in the proximal interphalangeal joint of the right middle finger. He exhibited complete immobility of proximal interphalangeal joints of the third, fourth, and fifth fingers of the left hand and similar findings in the right hand, except for partial motion (approximately 40 per cent) in the joint of the middle finger. Figure 1 shows the appearance of the hands when the patient attempted to double them into fists. Roentgenograms are reproduced in Figure 2.

The patient stated that he had six stiff fingers until the age of nineteen, when some motion developed in the joint of the right middle finger. He had been inducted into the Army, though with some hesitancy on the part of the examiner, and had been able to do full duty as a truck driver, without complaint. He was a good basketball player, but had recently "bumped" his right middle finger, causing some pain and swelling in the joint. It was because of this that he presented himself for examination.

Roentgenograms were made of the entire skeletal system. The only additional findings of significance were in the feet (Fig. 3), consisting in symphalangism of the distal interphalangeal joints of the third, fourth, and fifth toes bilaterally and fusion of the talus and navicular, and of the calcaneus and cuboid, also bilaterally.

The patient stated that the hands of his older brother, mother, maternal uncle, and maternal grandfather were affected in the same manner as his own. The latter three were deceased, but a trip was made to the patient's home in West Virginia to see the brother and obtain roentgenograms. The findings were about the same as in the original patient, with variations only in degree. The brother had served thirty months in the Navy and gave a history of some pain in the ankles on prolonged standing. He stated, further, that he was unable to grasp the ropes on the sides of the ship firmly enough to hold his weight, unless a knot was made. The mother was said to have been adept at sewing in spite of her stiff fingers.

Fig. 1. Appearance of hands (dorsum of right hand, plantar surface of left) when the patient attempted to double them into fists.

French authors apparently were the first to describe hereditary ankylosis of phalangeal joints—Mercier (2) in 1838 and Moutard-Martin and Pissavy in 1895 (3). According to O'Donoghue and Sell (4), Anderson in 1879 was the first to discover talonavicular synostosis, during dissection of a cadaver. In 1901, Walker (5) described a family resident in Virginia, with varying degrees of ankylosis and actual absence of the phalanges.

Dr. Harvey Cushing, as stated above, named the condition symphalangism in 1916. He studied a large family that came originally from Scotland in 1700 and settled in Virginia. In explanation of the condition, he stated that the middle phalanges are the last group or row of phalanges to ossify, which may explain their relative shortness and their tendency to fuse. Where less than four fingers are affected, the fusion occurs in those away from the index finger. It is possible that the trait may be transmitted in its most outspoken form by a parent in whom it is inconspicuous, but never by unaffected parents.

In the family studied by Cushing, the condition had been transmitted through seven generations. Of 302 individuals comprising 72 families in the Virginia branch for whom full records were available, 25.8 per cent were affected. Of 150 children of affected parents, 78, or 52 per

[1] Accepted for publication in October 1950.

Fig. 2. Anteroposterior view of both hands. Note partial formation of proximal interphalangeal joint of right middle finger.

Fig. 3. Right ankle and foot, showing fusion of talus and navicular bones and of calcaneus and cuboid; also symphalangism of distal interphalangeal joints of third, fourth, and fifth toes.

cent, showed the anomaly. The trait thus behaves as a simple mendelian dominant, with an equal chance that it will or will not be inherited.

Drinkwater (6) in 1917 presented before the Pathology Section of the Royal Society of Medicine (Great Britain) a case of symphalangism with a familial history. The condition was known to have been present in at least two preceding generations, as well as in a half-brother of the patient. In some of these cases there was more or less involvement of the metacarpal and metatarsal bones. In some there was slight motion of the proximal interphalangeal joint of the middle finger. Drinkwater's patient was a descendant of John Talbot, First Earl of Shrewsbury (died 1453), who is known to have had a similar ankylosis of the finger bones, and it is proposed by Gates (7) that all the cases reported in Great Britain and the United States may stem from this same source.

R. A. Hefner (8) in 1924 described a family with symphalangism which he believes (personal communication) is related to Cushing's family.

O. L. Inman (9), also in 1924, presented a study of four generations in which the distal joint of the second and fifth fingers and both joints of the last four toes of the feet were fused. Steinberg and Reynolds

(10) have recently (1948) presented more data on Inman's cases and believe that this type of distal joint involvement is different from proximal joint involvement. They do not believe that their patients are related to those of Hefner and Cushing.

Elkin (11), in 1925, studied five generations with symphalangism similar to the cases reported by Cushing. He now feels that the families may have been related (personal communication). Rochlin (12), in 1928, reported in the German literature symmetrical fusions of carpal bones in association with symphalangism. In the same year Hall (13) described cases in two Chinese families. Wilmoth (14), in 1930, reported cases from Baltimore, with absence of the proximal phalangeal joints in four fingers, absence or fusion of the distal joint in the ring finger, and abnormally short metacarpal bones of the thumb. All the tarsal-metatarsal joints were fused with the exception of the large toes. The terminal phalangeal joint of the second toe of each foot was missing.

In 1934 Mestern (15) in the German literature reported cases of symphalangism with associated brachydactyly, carpal and tarsal bone fusions, and clinodactyly (fingers bent in radial direction). In 1937 Pol (16) summarized the cases and work of Walker, Drinkwater, Cushing, and Mestern in Schwalbe and Gruber's comprehensive German work on malformations. In 1937, also, another case was recorded in the American literature, by Bloom (17), who believed it to be the first example reported with complete fusion of the tarsal bones, shown radiologically.

Freud and Slobody (18), in 1943, partially summarized the literature and presented 4 cases of symphalangism in the children of a Negro family. The condition was found to occur also in the father and the grandfather, the latter being an American Indian.

O'Donoghue and Sell (4) in 1943 reported the first cases of congenital synostosis of the talus and navicular (bilateral) studied radiologically. In 1945, Henry (19) reported anomalous fusion of the scaphoid and greater multangular in one wrist. The same year Mahaffey (20) described a case of bilateral congenital calcaneocuboid synostosis.

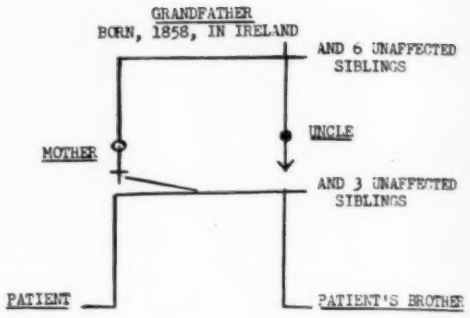

Fig. 4. Affected members of family in three generations.

It is, of course, impossible to determine the exact relationships of affected families in all cases, because of incomplete data. It does appear that the families of Walker, Cushing, Hefner, and Elkin are related, though this is not definitely proved. Undoubtedly, as pointed out by Gates, the American and British cases have a family relationship, being possibly traceable to the Earl of Shrewsbury.

SUMMARY

A case of symphalangism with related tarsal bone synostoses was observed in a twenty-year-old male whose older brother, mother, maternal uncle, and maternal grandfather were similarly affected. The case may represent a new family showing this condition. Families reported by certain other American and British writers are believed to be related.

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SUMARIO

Sinfalangismo y Fusiones Relacionadas de los Huesos Tarsianos

Este caso de sinfalangismo con sinostosis asociadas de los huesos del tarso fué observado en un joven de veinte años, cuyos hermano mayor, madre y tío y abuelo maternos se hallaban afectados en forma semejante. Esa clase de sinfalangismo de los dedos de las manos y los pies con fusión de los huesos tarsianos no había sido descrita antes en la literatura estadounidense. El caso puede también representar una nueva familia que manifestó dicho estado. Parece que las familias descritas por otros autores estadounidenses e ingleses estaban emparentadas.

Demonstration of the Duct of Wirsung Through a Pancreatico-Cutaneous Fistula[1]

DAN REIKES, M.D.,[2] and J. R. NAHON, M.D.

SATISFACTORY demonstration of the pancreatic duct by injection of an opaque medium has been reported in the medical literature both as an accidental (1) and as a deliberate procedure (2, 3). In most cases the injection was achieved *via* a T-tube placed in the common duct following surgery on the gallbladder. When the sphincter of Oddi remained contracted, reflux of the dye into the duct of Wirsung could occur. Contraction of the sphincter, however, is only occasionally sufficient to prevent the medium from passing out into the jejunum before filling the pancreatic duct. To meet this objection, H. Doubilet (2) has used morphine to contract the sphincter of Oddi and thus permit filling of the pancreatic radicles.

The material used for this procedure may be either sodium iodide, iodized oil, or a water-soluble opaque medium such as diodrast. All have been used successfully and without apparent harm to the patient. No cases of pancreatitis have been reported. Carter (3) states that the only untoward reaction has been shock secondary to pain from dilatation of the ducts. He therefore injects his medium under low pressure, using the gravity method.

Both water-soluble and oil-soluble media have their advantages and disadvantages. The water-soluble media are miscible with the pancreatic and biliary secretions, thereby producing a homogeneous column of dye. On the other hand, mucus or other secretions within the duct system may fail to mix with oil-soluble agents and thus produce defects in the column. Water-soluble agents disappear rapidly, whereas oil-soluble agents can be visualized for long periods of time.

Fig. 1. Left lateral view demonstrating the duct of Wirsung, the accessory pancreatic radicles, and a jejunal diverticulum, all outlined by 7 c.c. of iodized oil. The fistulous tract is delineated by the catheter and a slight amount of oil.

P. C., a 58-year-old male, was admitted to Halloran Veterans Administration Hospital on April 15, 1948, complaining of jaundice, pruritus, cramping pain in the right upper abdominal quadrant, periodic in nature, extremely dark urine, and light stools.

Laparotomy revealed granulation tissue obstructing the sphincter of Oddi. This was resected, and the patient was symptom-free until November 1949. In January 1950, he was readmitted to the hospital because of a recurrence of symptoms He showed jaundice, some cachexia, and a weight loss of 22 pounds

Laboratory findings were as follows: Blood count normal; serum amylase, 176 Somogyi units; serum bilirubin, 2.3 mg. per cent (0.9 mg. per cent direct, and 1.4 mg. per cent indirect); serum alkaline phosphatase, 16.1 units; stool negative for occult blood.

[1] From Halloran Veterans Administration Hospital, Staten Island, N. Y. Accepted in September 1950.
[2] Resident at Halloran Veterans Administration Hospital.

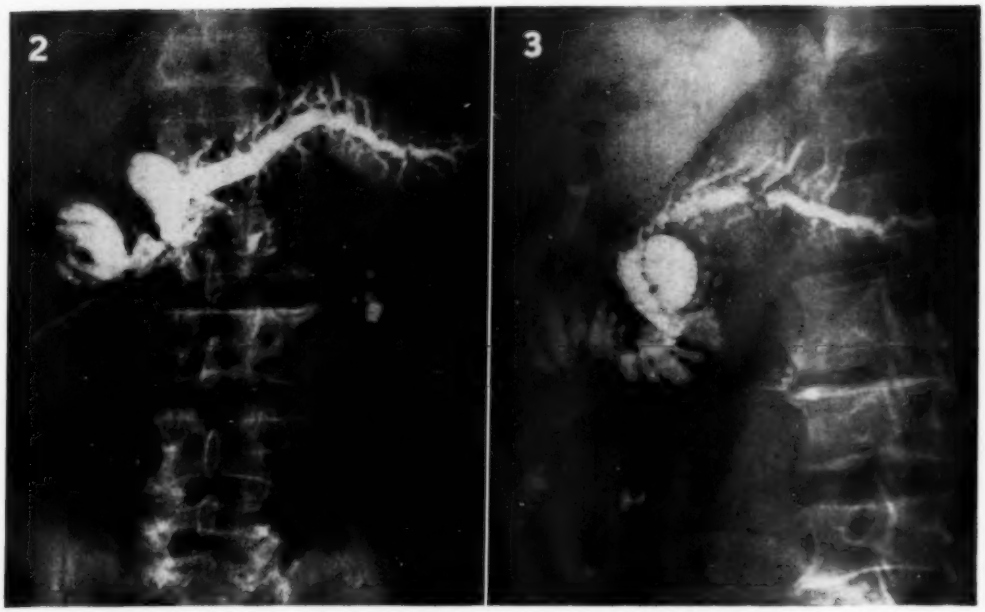

Fig. 2. Anteroposterior view after injection of an additional 10 c.c. of oil. The main and accessory pancreatic ducts are well shown. To the right, oil is commencing to overflow into the jejunum.

Fig. 3. Right anterior oblique view, showing the adjacent jejunum, the mucosal folds now clearly outlined by oil. The point of junction of the duct of Wirsung with the jejunum is well shown.

On Feb. 6, 1950, laparotomy was again performed, revealing a carcinoma of the ampulla of Vater. A partial pancreatico-duodenectomy and gastrojejunostomy were performed; a T-tube was left in the common duct, and a drain was inserted through a stab wound in the right hypochondrium. Fifteen days postoperatively the drain was removed. A fistulous tract formed at the site of the stab wound, intermittently secreting a clear serous fluid. Repeated examinations showed this to be almost pure pancreatic juice.

In order to study all of the ramifications of the sinus tract, and to determine whether it communicated with the bowel, it was decided to instill an oil-soluble radiopaque medium into the tract. A fine ureteral catheter was inserted as far as it would pass into the fistula, and 7 c.c. of oil were injected. Fluoroscopically, this was seen to outline the duct of Wirsung and all its radicles (Fig. 1). A jejunal diverticulum was also visualized. Since the primary purpose was to demonstrate the ramifications of the fistulous tract and any possible communication with the bowel, an additional 10 c.c. of oil were injected (Figs. 2 and 3). Almost immediately the patient complained of severe epigastric pain, which was incompletely alleviated by 100 mg. of demerol.

A serum amylase determination several hours after instillation of the opaque oil was at the upper limits of normal. On the following day, the patient's temperature rose to 102°, and his white blood count to 33,000, with 96 per cent neutrophils. The serum amylase at this time had slightly decreased and was well within normal range. Over a period of four days the temperature gradually receded and became normal. Pain continued moderately severe for two days following the sinus injection. By the seventh day recovery was complete. At this time the white count was found to be 11,000 with 79 per cent neutrophils.

Fig. 4. A twenty-four-hour film. The jejunal diverticulum remains outlined by retained oil.

Several weeks following the sinus-tract injection the patient was re-explored, and the fistulous tract was inserted into the jejunum. The jejunal diverticulum seen roentgenologically was identified.

The patient is now doing well. It is interesting to observe that the only reaction to the introduction of the opaque medium was pain, accompanied by fever and leukocytosis, with no elevation of the serum amylase. No residual change is clinically demonstrable as a result of the procedure.

SUMMARY

A case is reported in which the pancreatic duct of Wirsung was directly injected with radiopaque oil through a cutaneous fistula. The only untoward reactions were pain, fever, and leukocytosis, from which the patient made a complete recovery.

Halloran Veterans Administration Hospital
Staten Island, N. Y.

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SUMARIO

Observación del Conducto de Wirsung a Través de Fístula Pancreato-Cutánea

En el caso comunicado, el conducto pancreático de Wirsung fué llenado directamente con aceite radioopaco, inyectado a través de una fístula cutánea, formada después de una operación por carcinoma de la papila de Santorini, habiendo tenido esto por objeto estudiar las ramificaciones del trayecto de la fístula y determinar si se comunicaba con el intestino. Las únicas reacciones contraproducentes consistieron en dolor, fiebre y leucocitosis, de lo cual se repuso el enfermo por completo.

EDITORIAL

Peptic Ulcer in Childhood

In studying the literature pertaining to peptic ulcer, one is struck with the relatively small number of contributions concerned with ulcers occurring before the age of fourteen. This may be accounted for by a variety of circumstances.

Actually peptic ulcer is probably of less frequent occurrence in children than in adults. When it is present, the patient may be unable to describe his symptoms accurately, and the condition goes unsuspected until bleeding supervenes. The roentgen examination is more difficult, requiring the utmost patience because of the timidity of the child and the pylorospasm which is known to occur so frequently in these young patients. It is probable, also, that the clinician is less alert to the possibility of ulcer because of the many other congenital abnormalities and dietary problems connected with his practice, and in view of the generally accepted opinion that peptic ulcer is rare at so early an age.

If one excludes ulcers of the newborn and those developing in connection with exanthematous diseases, gastric ulcer is a very uncommon finding in children between the ages of two and fourteen years. Recently Ingram found reports of only 32 cases, to which he added one of his own. In the same month a similar case was reported by Martin and Saunders. In each of these two instances a roentgenologic diagnosis was made; an ulcer crater was demonstrated and was subsequently shown to have disappeared following medical management. Of the total of 34 gastric ulcers reported in the literature, 16 were discovered on roentgen examination, 5 at autopsy, and 13 at operation. Of the 17 cases reported since 1932, all but 3 were found roentgenologically.

It is well authenticated that the usual classical symptoms of gastric ulcer, as seen in adults, are not as a rule present in children, nor is deep epigastric tenderness elicited. Hemorrhage from the stomach is often the first and may be the most important sign of peptic ulceration in infancy. Gross hemorrhage is a serious complication and contributes materially to the poor prognosis.

The pathological changes found in these young patients are often more extensive than would be expected. The ulcer crater may be quite large and penetrating, and the incidence of perforation is higher than in adults. Gottlieb, Chu, and Sharlin, among others, have reported perforated gastric ulcer in the newborn.

Many theories have been advanced to account for the etiology of peptic ulcer in children but there is no general agreement on this subject. It is said to be more frequent following the acute exanthemata. Cushing showed that many gastric ulcers are of neurogenic origin and demonstrated their occurrence following brain surgery, especially in the cerebellar area.

Duodenal ulcer is of much more common occurrence in children than gastric ulcer, as is true also of adults. Among 9 cases of peptic ulcer seen at autopsy in the Glasgow Royal Hospital for Sick Children, Guthrie found 8 to be duodenal and one gastroduodenal. In her experience, duodenal ulcer occurs almost exclusively above the ampulla of Vater on the posterior wall.

Elsewhere in this issue of RADIOLOGY, Alexander reports 30 cases of duodenal ulcer found in the routine work of the x-ray department of a general hospital and his own private office practice. His paper merits careful reading. It shows what can be accomplished by careful attention to detail by an enthusiast on the subject.

It is apparent that ulcers in children may be divided into two classes on an age basis. Those occurring in infants are often associated with infections, circulatory disorders, trauma (as in difficult labor), or cachexia. In older children the lesions may be of obscure origin, as in the adult. All but one of Guthrie's patients were under twelve months of age. It is in this age group that sudden hemorrhage, with or without perforation, may be the first sign of the condition, and the mortality is high as compared with the older group. Beyond the age of five the ulcers are more likely to be of a chronic nature and are more closely comparable to those seen in adult life, though many authors feel that such lesions are rare before puberty.

From a review of the literature and the excellent report of Alexander, it would appear that peptic ulceration in childhood has been somewhat neglected from a roentgenologic standpoint. It is entirely probable that it is much more common than has been believed. It must be suspected in all cases of indefinite abdominal pain in children. A careful history and physical examination will do much to direct attention to its possibility and indicate the need of appropriate roentgen examination.

The roentgen signs of peptic ulcer in children are essentially the same as those in adults with similar lesions. The demonstration of the ulcer crater is necessary to establish the diagnosis beyond question. The difficulties of roentgen examination incident to lack of co-operation on the part of these young subjects are increased by the presence of the high transverse type of stomach, excessive air in the stomach, and pylorospasm.

Unquestionably the possibility of peptic ulceration in children should be given greater publicity, and a sincere effort should be made to improve our technic of handling these young patients. This will not only contribute to more accurate diagnosis, but will probably do much to establish the true incidence of the disease in infancy and childhood.

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ANNOUNCEMENTS AND BOOK REVIEWS

CHICAGO ROENTGEN SOCIETY

The newly elected officers of the Chicago Roentgen Society are Dr. Frank L. Hussey, President; Dr. Roger A. Harvey, Vice-President; Dr. Benjamin D. Braun, 6 North Michigan Ave., Chicago 2, Secretary-Treasurer.

FLORIDA RADIOLOGICAL SOCIETY

The following were elected at the recent annual meeting of the Florida Radiological Society to serve for the ensuing year: Dr. John J. McGuire, Pensacola, President; Dr. Thomas H. Lipscomb, Jacksonville, Vice-President; Dr. Nelson T. Pearson, 1109 Huntington Bldg., Miami, Secretary-Treasurer.

PREMIER CONGRES DES MEDECINS ELECTRORADIOLOGISTES DE CULTURE LATINE et VIIIe CONGRES DES MEDECINS ELECTRORADIOLOGISTES DE LANGUE FRANCAISE

The Eighth Congress of the French Speaking Electro-Radiologists and the First Congress of the Electro-Radiologists of Latin Culture will be held jointly at the Palais des Beaux Arts in Brussels, July 23–28, 1951, under the patronage of Her Majesty Queen Elizabeth. Professor J. Maisin is President of the Congress. Further details may be obtained by addressing the Secrétariat Général du Congrès, 150, Rue de Linthout, Brussels, Belgium.

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES

The program for the 1951 Oak Ridge Summer Symposium on "The Role of Engineering in Nuclear Energy Development" has been completed. The symposium will be held at Oak Ridge from Aug. 27 to Sept. 7. Sessions will be unclassified in nature and are open to all interested professional engineers and others.

Additional information may be obtained from: the University Relations Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

DR. JAMES F. BRAILSFORD HONORED

Friends of Dr. James F. Brailsford of Birmingham, England, will be happy to know that Birmingham University has recently conferred upon him the title "Emeritus Director of Radiological Studies in the Living Anatomy." Dr. Brailsford has been actively engaged in radiology at the university for thirty-six years.

ERRATUM

Dr. L. R. Sante wishes to call attention to an error which escaped his attention in his paper on "Evaluation of Aortography in Abdominal Diagnosis" in RADIOLOGY for February 1951. On page 184, in the fourteenth and fifteenth lines from the bottom of the first column the words "a 15-cm. No. 12 gauge . . . " should read "a 15-cm. 18 to 16 gauge . . . "

ARMY FILMS ON MEDICAL SUBJECTS

The following list of films available through the U. S. Army on a loan basis to the medical profession and allied scientific groups is published as a supplement to the paper by Brig. Gen. Elbert DeCoursey on "Injury from Atomic Bombs," in RADIOLOGY for May 1951.

PMF 5058. The Medical Effects of the Atomic Bomb. Part I: Physics—Physical Destruction Casualty Effects (color, sound, 32 minutes running time)

PMF 5110. Radioactivity (color, sound, 17 min.)

PMF 5143. Atomic Medical Cases—Japan, World War II (black and white, sound, 37 min.)

PMF 5148. The Medical Effects of the Atomic Bomb. Part II: Pathology and the Clinical Problem (color, sound, 37 min.)

PMF 5149. The Medical Effects of the Atomic Bomb. Part III: Medical Service in Atomic Disaster (color, sound, 28 min.)

*PMF 5151. General Adaptation Syndrome (color, sound, 84 min.)

MF 1396. Crossroads Radiological Safety Motion Picture (black and white, sound, 25 min.)

Film Strips

FS 8-65. Chemical Warfare Injuries, Prophylaxis and Therapy. Part I: Lung Irritants (color)

FS 8-66. Chemical Warfare Injuries, Prophylaxis and Therapy. Part II: The Vesicants (color)

FS 8-67. Chemical Warfare Injuries, Prophylaxis and Therapy. Part III: The Vesicants (color)

FS 8-68. Chemical Warfare Injuries, Prophylaxis and Therapy. Part IV: Miscellaneous Agents (color)

FS 8-74.	The Morphine Syrette
FS 8-80.	The First Aid Kit for Gas Casualties
SFS 8-110.	First Aid for Chemical Casualties
ANSM 74.	Tale of Two Cities
ANSM 86.	Atomic Power
OF 46.	Inside the Atom
Misc. 1235.	The Atom Strikes
Misc. 7500.	Atomic Energy
Misc. 7534.	The Last Bomb

Requests for this material, except as otherwise noted, should be directed to the Commanding General of the Army Area in which the requesting institution or individual is located, as follows:

Commanding General, First Army, Governors Island, N. Y., Attention: Surgeon. Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, and New Jersey.

Commanding General, Second Army, Fort Meade, Md., Attention: Surgeon. Ohio, Pennsylvania, Virginia, West Virginia, Maryland, Kentucky, and Delaware.

Commanding General, Third Army, Atlanta 3, Ga., Attention: Surgeon. Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

Commanding General, Fourth Army, Fort Sam Houston, Texas, Attention: Surgeon. Texas, New Mexico, Oklahoma, Arkansas, and Louisiana.

Commanding General, Fifth Army, 1660 East Hyde Park Boulevard, Chicago, Ill., Attention: Surgeon. Illinois, North Dakota, South Dakota, Minnesota, Iowa, Wisconsin, Michigan, Wyoming, Nebraska, Colorado, Kansas, Indiana, and Missouri.

Commanding General, Sixth Army, Presidio of San Francisco, Calif., Attention: Surgeon. California, Washington, Montana, Idaho, Oregon, Nevada, Utah, and Arizona.

There are available, also, from the Armed Forces Institute of Pathology, Medical Illustration Service, Seventh St. and Independence Ave., S. W., Washington 25, D. C., lantern slides on The Effects of the Atomic Bomb on Japan (2 × 2 in., color; 3 1/4 × 4 in., black and white and color).

All transportation charges must be paid by the civilian requestor.

* Available from Director, Armed Forces Institute of Pathology, Washington 25, D. C., Attention: Chief, Medical Illustration Service.

INTERNATIONAL CONGRESS OF RADIOLOGY

A limited number of reprints of the Recommendations of the International Commission on Radiological Protection and of the International Commission on Radiological Units, both of which were revised during the Sixth International Congress of Radiology, London, 1950, are available at the Congress Office in London. Applications should be addressed to the Secretary-General, Sixth International Congress of Radiology, 45 Lincoln's Inn Fields, London W. C. 2.

J. W. McLAREN, *Secretary General*

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

Since the publication of an article concerning mesenteric lipoma by Dr. Daniel L. Fink and myself (Mesenteric Lipoma: Report of a Case with Distinctive Roentgenographic Features. Radiology **56**: 370–375, 1951), it has come to our attention that Dr. Joseph Selman and Dr. John R. Bender had previously described the roentgenologic findings in this type of tumor (Mesenteric Lipoma in a Child. Radiology **51**: 66–70, 1948). We regret that their article was not known to us when our paper was being written. This oversight was due to the fact that our account was prepared in the first part of 1949, when the Cumulative Index of the A.M.A., listing their publication was not yet available. We wish to take this means of correcting the error and recognizing their priority.

Sincerely,
E. F. EVERETT, M.D.
Minneapolis, Minn.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE NORMAL ENCEPHALOGRAM. By LEO M. DAVIDOFF, M.D., Director of Neurological Surgery, Beth Israel Hospital, New York City; Clinical Professor of Neurosurgery, New York University Postgraduate Medical School, and CORNELIUS G. DYKE, M.D., Late Associate Professor of Radiology in the College of Physicians and Surgeons, Columbia University; Late Director in the Department of Radiology of the Neurological Institute of New York, New York City. A volume of 240 pages, with 190 illustrations. Third edition, thoroughly revised by LEO M. DAVIDOFF, M.D. Published by Lea & Febiger, Philadelphia, 1951. Price $6.00.

THE ABNORMAL PNEUMOENCEPHALOGRAM. By LEO M. DAVIDOFF, M.D., Director of Neurological Surgery, Beth Israel Hospital, New York City; Clinical Professor of Neurosurgery, New York University Postgraduate Medical School, and BERNARD S. EPSTEIN, M.D., Associate Radi-

ologist, The Jewish Hospital of Brooklyn, Brooklyn, N. Y., and Instructor in Clinical Radiology, Long Island College of Medicine. A volume of 506 pages, with 695 illustrations. Published by Lea & Febiger, Philadelphia, 1950. Price $15.00.

A TEXT-BOOK OF X-RAY DIAGNOSIS. By British Authors. In four volumes. Edited by S. COCHRANE SHANKS, M.D., F.R.C.P., F.F.R., Director, X-Ray Diagnostic Department, University College Hospital, London, and PETER KERLEY, M.D., F.R.C.P., F.F.R., D.M.R.E., Director, X-Ray Department, Westminster Hospital; Radiologist, Royal Chest Hospital, London. Vol. I. THE HEAD AND NECK. A volume of 434 pages, with 439 illustrations. Price $12.00. Vol. II. THE CHEST. A volume of 702 pages, with 605 illustrations. Published by W. B. Saunders Co., Philadelphia, 2d ed., 1951. Price $15.00.

CONFRONTATIONS RADIO-ANATOMO-CLINIQUES. Fascicule IV. Published under the direction of M. CHIRAY, R. A. GUTMANN, AND J. SÉNÈQUE. A volume of 68 pages, with 127 illustrations. Published by Masson et Cie, Paris, 1951. Price 1250 fr.

Book Reviews

RADIOLOGY OF THE TEETH AND JAWS, INCLUDING DENTAL RADIOGRAPHY. FOR STUDENTS AND PRACTITIONERS OF DENTAL SURGERY AND RADIOLOGY. By FRANK L. INGRAM, D.M.R.D., L.D.S., M.R.C.S., L.R.C.P., Senior Assistant in the Diagnostic X-Ray Department of Guy's Hospital, Lecturer in Dental Radiology at Guy's Hospital Dental School. A volume of 128 pages, with 281 illustrations. Published in the United States by Williams & Wilkins Co., Baltimore, 1950. Price $3.50.

This brief treatise from Guy's Hospital, London, on the radiographic examination of the teeth and jaws will be valuable to the student and to the radiologist who wishes a ready source of reference to the perplexing dental problems which all too often he is inclined to avoid.

The opening chapter of Part I on "simple physics" and the processing of films might well have been omitted, as it includes only the most elementary information. The succeeding chapters, describing the filming of the various areas, are well done and will be of practical value. A final chapter in this section is devoted to the development of the teeth and dental radiography in children.

Part II takes up the pathological conditions encountered: caries, parodontal disease, trauma, errors of development, osteomyelitis, residual sepsis and antral infections, cysts, benign and malignant tumors, bone dysplasias, and conditions affecting the temporomandibular joint.

The monograph is well illustrated, chiefly by reproductions of radiographs. It is printed on good paper and well bound. An adequate index is included.

RESEARCHES ON THE RADIOTHERAPY OF ORAL CANCER. By CONSTANCE A. P. WOOD and J. W. BOAG (with P. HOWARD-FLANDERS, A. GLÜCKSMANN, L. H. GRAY, and F. G. SPEAR). Medical Research Council Special Report Series No. 267. A monograph of 148 pages with 77 text illustrations, 30 plates in half tone and color, 2 color charts, and 31 tables. Published by His Majesty's Stationery Office, 429 Oxford St., London, W. I., 1950. May be obtained through the British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. Price 12*s.* 6*d.* Net.

This most interesting pamphlet deserves attention from any radiologist concerned with the relation of wave length to biological effects. One section is devoted to a discussion of a clinical experiment in which 185-kv.p. radiation and teleradium radiation were compared on the basis of beam quality alone. It was demonstrated that with roentgen radiation a skin erythema developed more rapidly and was more severe and that the mucous membrane reaction occurred at a lower dosage. A technic of combined x-ray and radium therapy—using one of symmetrical fields for one modality and the contralateral field for the other—made possible a comparison of identical dosage in the same patient. By this dual technic, the ratio of the gamma-ray dosage to that of x-radiation required to produce an identical biologic end-point (erythema) was established as 1.34. A comparison of the clinical results (survival) in a series of patients also appears to favor radium therapy, but analyzed statistically the figures fail to bear out this advantage. The reader should examine the figures employed in reaching this conclusion, for they reveal how proper statistical analysis may give the lie to ordinary clinical interpretation.

No less interesting to many will be a statistical study of different factors in the history and treatment response of oropharyngeal cancer. Most arresting is the conclusion that the regression of involved nodes "was strongly correlated with the regression time of the primary tumor and that there were about as many cases in which the glands responded more rapidly than the tumor as there were cases in which the tumor responded more rapidly than the glands. This finding is not in agreement with frequent statements in the literature that glands do not respond as well to radiotherapeutic treatment as does the primary tumor." The authors, incidentally, treated the regional nodes as intensively as the primary lesion. Analysis revealed very distinct improvement in survival time among all treated patients despite the relatively low five-year figures.

Yet another section deals with histopathology, revealing that a valid histologic prognosis can be made, compatible with clinical end-results, that radiation failures may be due in part to persistence of precancerous lesions, and lastly that promotion of differentiation is an important factor in tumor sterilization. In this connection is found the interesting assertion that "the lower cure rate for anaplastic tumors is explained by the fact that such tumors have a high incidence of lymph node involvement and tend to respond poorly to radiotherapy both at the primary site and in the glands."

THE RESULTS OF RADIUM AND X-RAY THERAPY IN MALIGNANT DISEASE, Being the Third Statistical Report from the Radium Institute, The Christie Hospital and Holt Radium Institute, Manchester. Years 1940 to 1944 inclusive assessed at five years and 1934 to 1938 assessed at ten years. Compiled by RALSTON PATERSON, MARGARET TOD, and MARION RUSSELL. A volume of 168 pages, with 63 tables. Published by E. & S. Livingstone, Ltd., Edinburgh, 1950. Price $2.50.

This small volume is not simply a tally of survival figures but contains a good share of text. It is introduced with a brief historical account of the Christie Hospital and Holt Radium Institute and continues in three sections. The first explains the statistical methods employed, showing how survival figures can be corrected for likelihood of death from other causes, a useful concept. It includes short commentaries on various cancers and groups of cancer, accompanied by tables of treatment results. Part II is concerned with details of treatment technics and relevant data. Part III is a résumé of ten-year results. Taken as a whole, the work is in a sense a supplement to Paterson's well known monograph on radiotherapy and should be available in departmental libraries.

THE CANCER PATIENT. A NEW CHEMOTHERAPY IN ADVANCED CASES. By B. A. MEYER, M.B., Ch.B. (Ed.), L.R.C.S. & P. (Ed. & Glas.) AND I. S. ORGEL, M.D. (Dublin). A volume of 88 pages. Published by J. & A. Churchill, Ltd., London, 1950. Price 7s. 6d.

The authors have devised a new approach to the palliation of far advanced cancer based on (1) the assumption of a disturbance of ascorbic acid metabolism in malignant disease and (2) use of a growth inhibitor derived from cankerous trees.

Outstanding among the effects reported to have been produced clinically were (1) rapid pain relief; (2) an improved sense of well-being and appetite; (3) increased radioresponsiveness; (4) diminished susceptibility to systemic effects of radiation.

Ascorbic acid disturbance, as manifested by deposition of non-utilizable ascorbic acid at the site of tumor, general ascorbic depletion in cancer patients, and deranged "C" metabolism due to injured Golgi apparatus, appears from the authors' discussion and references to be a valid observation in cancer. Resistance of trees to cancer-like growths appears also to be a well founded observation. Theoretically, therefore, therapy employing ascorbic acid and a plant-borne inhibitor seems justifiable. Some experimental data are presented; case histories are cited.

This is an interesting preliminary report; it seems scholarly. The American reader, however, would like to know a little more about the authors than is presented. The information about the growth inhibitor is sketchy.

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER, with contributions by E. BRANDENBERGER, A. BRUNNER, U. COCCHI, N. P. G. EDLING, J. EGGERT, F. K. FISCHER, M. HOLZMANN, H. KRAYENBÜHL, A. LINDBOM, E. LINDGREN, G. A. PREISS, S. WELIN, AND A. ZUPPINGER, Vol. I. The Skeletal System. Part III. A volume of 528 pages, with 732 illustrations. Published by Georg Thieme, Stuttgart, 5th completely revised edition, 1951. Sole distributors for U. S. A. and Canada: Grune & Stratton, Inc., 381 Fourth Ave., New York 16, N. Y. Price $19.50.

Parts I and II of Volume I of this completely revised and rewritten classic have been reviewed in an earlier number of RADIOLOGY (**56**: 122, January 1951). Part III continues the presentation of the roentgenology of the skeleton. The opening 51 pages complete a chapter on bone tumors begun in Part II with the space allotment here given to the malignant varieties. The high quality of text and illustrations is maintained.

Six chapters, M to R inclusive, comprise the remainder of the book:

M. Metastatic Bone Tumors. The line drawings illustrating the distribution patterns of metastases are superb. General discussion is not detailed, but many specific observations, such as the resemblance of some metastatic neurosarcomas to Ewing's sarcoma, are mentioned.

N. Skeletal Malconstruction. This chapter treats primarily of teratology. The inclusion of clubfoot, birth injuries of the shoulder, cubitus valgus and vara, since they are only indirectly related to the monstrosities, seems somewhat out of place.

O. Bone Disturbance of Vitamin Origin. Hyper- and hypovitaminoses are adequately presented.

P. Dwarfism and Gigantism. This, a contribution by U. Cocchi, provides one of the pinnacles of the book in the form of a chart for the differential diagnosis of proportionate and disproportionate dwarfism.

Q. Bone Disturbance of Hormonal Origin. In this chapter, a logical continuation of the previous one, the reader finds the details of those growth disturbances specifically related to the glands of internal secretion plus a discussion of a few bone diseases of questionable hormonal origin.

R. Diseases of the Joints. Contrast arthrography, roengten anatomy, traumatic joint diseases, the arthritides, the arthropathies, hereditary ailments and the postoperative appearance of joints comprise the material for the last and longest chapter.

GLI ISOTOPI RADIOATTIVI E LE LORO APPLICAZIONI IN MEDICINA E IN BIOLOGIA. By DOTT. GIOVANNI SCARZMOZZINO, Specialista in radiologia medica e terapia fisica. Istituto di radiologia medica e terapia fisica dell'Universita di Pavia. Preface by PROF. ARDUINO RATTI. A volume of 278 pages, with 48 illustrations. Edizioni Scientifiche Italiane, Naples, 1950.

This volume is the result of several years of study and scientific work by a young Italian radiologist who, following two years in radiological training, spent a year with Professor Mitchell of the Department of Radiotherapy at the University of Cambridge, England. Upon his return to Italy, he began to practise radiology under very difficult circumstances and was killed in 1950 by an accidental electrical discharge from his non-shockproof equipment. The publication of this volume was cared for by his teachers and friends of the University of Pavia.

The book consists of a thorough review of the available literature on the subject of radioactive isotopes. The various chapters deal with nuclear reactions in general, the modern technics for the acceleration of particles, the production of radioactive isotopes, radiological chemistry, characteristic radiations, measurement of radioactive isotopes, and medical and biological applications. The book is well organized and obviously represents a tremendous amount of careful work. It is indeed sad that the author should have died so young, before he could make practical application of his great theoretical knowledge.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

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NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club, Boston

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New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Peter J. Gianquinto, M.D., 685 High St., Newark 2. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

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KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

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THE HEAD AND NECK

Cerebral Arteriography. Robert E. Wise, C. Robert Hughes, and J. R. Hannan. Am. J. Roentgenol. **64:** 239–253, August 1950.

The authors review the normal anatomy of the internal carotid and its branches and report a study of 150 arteriograms. In this series, there were 38 tumors, 25 aneurysms, 8 vascular anomalies, 8 arteriovenous fistulas, and 1 case of thrombosis of the middle cerebral artery.

Of the 38 tumors, 12 were localized by arteriography alone and 5 were more accurately localized by arteriography than by air studies. By means of vascular displacement, localization of the tumor may be established, and by visualization of the vascular pattern or so-called "tumor stain" an estimate as to the type of tumor may be made. The characteristic patterns of displacement seen in frontal lobe, parietal lobe, temporal lobe, and occipital lobe tumors, as well as the tumor stains or vascular patterns frequently found with certain types of neoplasm, are discussed and illustrated.

Vascular lesions such as arteriovenous fistulas and arteriovenous anomalies lend themselves well to visualization by arteriography. Both types of lesion are illustrated. Aneurysms of the internal carotid artery and of the circle of Willis and its branches may be suspected clinically and at times may be localized by calcification of the aneurysmal wall or by destructive changes about the sella turcica, but arteriography permits direct visualization and affords information as to size and location. Of the 25 aneurysms in this series, 21 were visualized by arteriography.

In the single case of cerebral thrombosis, there was filling of all of the usual vessels with the exception of the middle cerebral and its branches. Thrombosis should not be diagnosed, however, without adequate corroborative clinical findings. Sometimes reinjection will produce filling of the suspected vessel.

The authors conclude with a brief discussion of reactions and contraindications to cerebral arteriography. Ten illustrative cases are presented.

Twenty-seven roentgenograms; 3 drawings.

WILLIAM H. SMITH, M.D.
University of Louisville

Further Experimental Investigations of Injuries from Contrast Media in Cerebral Angiography. Summation of Various Injurious Factors. Tore Broman, Bengt Forssman, and Olle Olsson. Acta radiol. **34:** 135–143, July-August 1950.

The authors have previously shown experimentally that various contrast media of the diodrast group are capable of injuring cerebral vessels of laboratory animals (Broman and Olsson: Acta radiol. **30:** 326, 1948, and **31:** 321, 1949. Abst. in Radiology **53:** 624, 1949, and **54:** 767, 1950). This writing deals with determining the possibility of brain injury from (1) repeated injections of contrast medium at certain intervals, (2) temporary blockade of the arterial circulation of the brain, and (3) the simultaneous effect of another chemotoxic factor administered with or before diodrast-like material. The injections were made directly into the carotid artery for these experiments.

Repeated injections of umbradil at intervals of a few minutes, with the application time of the individual injection not exceeding thirty seconds, produced a disorder in the permeability of the cerebral vessels on the injected side, frequently associated with clonic convulsions. When the cerebral circulation was retarded by arterial and venous ligations, the application time of the contrast medium was markedly increased. Thirty-five per cent umbradil produced no visible damage with an injection time up to forty seconds and an application time up to seventy seconds. Fifty per cent umbradil, however, led to vascular damage with a total application time of over fifteen seconds.

No summation effect of osmotic and chemotoxic factors could be determined when 1 per cent NaCl was mixed with 35 per cent umbradil. A definite disorder of cerebral vascular permeability occurred, however, when the umbradil (35 per cent) was injected immediately following an otherwise non-injurious dose of formalin. Less marked vascular damage occurred with injection of a 1 per cent solution of sodium taurocholate in 35 per cent umbradil. It is shown that the minimum application time necessary for either one of two injurious agents to damage the cerebral vessels can be considerably reduced if both agents are applied simultaneously.

Since cerebral disease may cause retarded circulation and other changes in the brain, there is reason to assume that, in spite of all precautionary measures, the cerebral vessels may occasionally be damaged, at least regionally, by cerebral angiography.

Four tables.

J. A. CAMPBELL, M.D.
Indiana University

Roentgenologic Manifestations of Acoustic Neuromas. Bernard S. Epstein. Am. J. Roentgenol. **64:** 265–276, August 1950.

After a review of the literature on the findings on both plain films and pneumoencephalographic examinations in acoustic neuromas, the author presents data compiled from 21 cases which he studied.

The bone changes on plain films of the skull are due to the pressure effect of the tumor on the auditory canal and adjacent petrous bones. If the principal growth of an acoustic neuroma occurs outside the auditory canal, there may be no visible roentgenographic alterations.

From his series, the author found that plain films of the skull in patients suspected of having an acoustic neuroma are best taken (1) in Towne's projection and (2) through the orbits, demonstrating the petrous pyramids. Other projections such as Stenvers', Law's, and stereo views of the base of the skull were less helpful. Displacement of the pineal body and roentgenologic evidence of increased intracranial pressure were infrequent (pineal visible and normal in position in 19 patients). Erosion of the ipsilateral posterior clinoid process was seen in two patients in Towne's views. The sella turcica was normal in size in every instance. The author concludes that positive information may be anticipated on the plain films in about 30 per cent of these cases.

Seven patients showed no changes on the plain films of the skull. Five of the number were studied with ventriculograms and two were studied with lumbar pneumoencephalograms. Four cases of this group are presented in detail, with abstracts of the clinical and laboratory features as well as the x-ray findings (illustrated) in each case.

The findings on pneumoencephalographic examination depend upon the changes in the posterior fossa arising from the tumor. If these are minimal, pneumoencephalography may disclose only slight or moderate hydrocephalus with neither distortion or displacement of the midline cerebrospinal fluid passages. This may occur when the effect of the tumor is to diminish the circulatory passages either at the aqueduct of Sylvius or at the outlet of the fourth ventricle. When the tumor extends laterally and upward, there is more likely to be pressure against the aqueduct and posterior aspect of the third ventricle, while with tumors which further encroach downward toward the foramen magnum variations in the configuration and position of the fourth ventricle may occur. These changes are due not only to the physical presence of the mass; of equal importance are the secondary effects, such as cerebellar edema and extension of the tumor to adjacent structures. It is also likely that a torsion effect is produced, causing rotary pressure effects on the aqueduct and fourth ventricle. Herniations of the brain stem upward through the incisura tentorii and of the cerebellum downward through the foramen magnum have been reported.

The specific changes noted in the pneumoencephalogram in the present series, as well as in cases previously reported, are enumerated in detail.

Twelve roentgenograms.

WILLIAM H. SMITH, M.D.
University of Louisville

Epidermoids of the Bony Structures of the Skull and of the Spinal Canal with Special Emphasis on the Roentgen Findings. Walter Dūben. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 484–493, February 1950. (In German)

Only a few cases of epidermoid tumors of the bony structures of the skull have been reported. The author adds 2 of his own observations. One of his patients was a 69-year-old male with a large honeycomb rarefaction of the left frontal bone extending into the parietal and temporal bones and causing a partial destruction of the orbit. The tumors were removed by radical surgery and the diagnosis was confirmed histologically. The second case was that of a 32-year-old female with an irregular and sharply defined rarefaction of the sphenoid bone with several calcifications in the center. This tumor was also removed surgically and the diagnosis was microscopically confirmed.

Up to 1939, only 8 cases of epidermoid tumors of the spine had been reported. Three cases are contributed here: one in a 36-year-old female showing large bone defects, with smooth borders, in the third, fourth, and fifth lumbar vertebrae, and varied neurological symptoms; one in a 35-year-old female with an obstructive lesion at the level of the first dorsal vertebra; and the third in a boy of three and a half years who complained of pains in the lower spinal region. In the two latter cases, the roentgen examination did not contribute to the diagnosis, which was made postoperatively.

The author comes to the conclusion that the diagnosis of epidermoid tumors of the bones can be made from roentgenograms. A bulging and swelling of the diseased bone with honeycomb rarefaction and sharp borders are characteristic.

Five roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Differential Diagnosis of Meningiomatous Changes of the Skull. E. Ruckensteiner. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 698–703, April 1950. (In German)

While cranial hyperostosis, bone defects, and increased vascularity may signify meningioma, similar bone changes occur in a variety of other diseases. Two cases of meningioma observed by the author are compared with a case of glioblastoma multiforme and a case of aberrant Langhans' struma which showed almost identical cranial lesions. Such bone changes have already been described and analysed in prehistoric skulls (see Abbott and Courville: Bull. Los Angeles Neurol. Soc. **4:** 101, 1939).

Six roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Retinal Fluoroscopy in Traumatic Lesions of the Eye. Cesare Gianturco. Selected Papers, Carle Hosp. Clin. & Carle Found. **3:** 42–44, July 1, 1950.

The intact retina can perceive roentgen rays as a bluish glow provided the eye is completely dark-adapted and all sources of visible light are eliminated. This phenomenon, in which the retina acts as a fluorescent screen, has been used for the localization of foreign bodies and as a means of detecting retinal damage when opacities of the aqueous lens or vitreous prevented fundus and field examination.

With the injured eye shielded by lead, the good eye receives an exposure of one second (70 kv., 10 ma., 1 mm. Al filtration, 10 in. focus-skin distance) to give the patient a basis of comparison. The injured eye is then exposed and, if shadows are observed in the illuminated retinal field, a second exposure is made while the tube is moved laterally for a distance of about 10 cm.

A metallic fragment within the eyeball will register a shadow if the retina is intact, and this shadow will shift as the tube is moved. The shadow of a foreign body embedded in the wall of the eye will remain constant in position but will change in shape with shifting of the tube. A retinal perforation will show up as a dark area changing neither in position or shape. If the retina is completely destroyed or the optic nerve severed, there is, of course, no perception.

One important point to remember is that roentgen rays are not refracted by the eye. The image produced is therefore reversed only once, by the visual center of the brain, so that in "retinal fluoroscopy" a foreign body or retinal tear seen by the patient as nasal is really temporal, superior is inferior, etc.

The author used this procedure in 26 patients, and in 13 obtained information of value. Five cases are briefly presented.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Fibro-Osteoma in the Mandible of a Child. Anders Sonesson. Acta radiol. **34:** 17–24, July-August 1950.

Fibro-osteomas are osteogenic ossifying tumors, usually occurring in the bones of the cranium. The author presents the case of a two-year-old child with a large expanding tumor of the mandible. Thin trabeculae extended into the tumor. Angiography was done and showed no pathologic vessels. The tumor was enucleated.

The author describes the roentgen picture as showing "a subtle but nevertheless visible polygonal pattern of characteristic appearance" in several areas. He be-

lieves that non-screen films might bring out the minute calcified osteoid structures to better advantage.

Six roentgenograms. J. G. LORMAN, M.D.
Indiana University

Intra-Osseous Mucus-Secreting and Cystic Epidermoid Carcinoma of the Jaw. Anders Sonesson. Acta radiol. **34:** 25–32, July-August 1950.

Mucus-secreting epidermoid carcinoma of the jaw arises from the epithelium of the ducts of the salivary and mucous glands. Osseous involvement stems from direct invasion with proliferation of the tumor, and characteristically occurs at the angle of the mandible. The growth is expansile, assuming a somewhat benign course, with its malignant character more evident after enucleation.

Radiographically, the bone shows cystic dissolution with a uni- or multilocular appearance. The only diagnostic clue is the destruction of the medial wall of the mandible, indicating invasion. A distinct cortical margin presents a benign roentgenographic appearance and complicates differentiation from mandibular and bone cysts of other origin.

Three cases are reported. Roentgenologically two of the tumors were originally believed to be adamantinomas.

Five roentgenograms. J. W. WILSON, M.D.
Indiana University

THE CHEST

Lung Cancer Operability. Angiocardiographic Study of Fifty-Three Consecutive Proved Cases of Lung Cancer. Charles T. Dotter, Israel Steinberg, and Cranston W. Holman. Am. J. Roentgenol. **64:** 222–237, August 1950.

The authors made a study of 53 cases of microscopically proved primary lung cancer in which angiocardiography was performed. It was found at the outset that prognostic as well as diagnostic information could often be gained by observation of the opacified mediastinal and pulmonary blood vessels.

A space-occupying lesion in the lung may, by external pressure, cause luminal narrowing or even obstruction of mediastinal vessels. Thrombosis or embolization of vessels may simulate neoplastic occlusion. Angiocardiography may demonstrate the crowding together or displacement of segmental vessels and thus suggest an atelectasis. A circumscribed tumor tends to spread or dislocate vessels, while invasive tumors cause irregular alterations in vascular contour or tend to produce occlusion. Infiltrative neoplasms and chronic pulmonary infections may produce evidence of avascularity. This must not be confused with reduced filling.

From an angiocardiographic point of view, inoperability in cancer of the lung is indicated by the following findings:

1. Partial or complete occlusion by tumor of the left pulmonary artery within 1.5 cm. of its origin. Partial or complete occlusion by tumor of the right pulmonary artery proximal to its point of bifurcation.
2. Partial or complete occlusion of the great mediastinal veins due to tumor in the mediastinum.
3. Demonstration of mediastinal metastases by contrast delineation and deformity of adjacent vascular structures. This consists in the demonstration of masses within the mediastinum through external pressure defects on vessels.
4. Demonstration of pericardial invasion by tumor.

In view of the fact that inflammatory processes may simulate any of the above changes, the authors feel that no patient should be denied exploratory surgery on the basis of angiocardiographic findings alone.

Ten roentgenograms; 10 line drawings; 1 table including details of the authors' 53 cases.

I. R. BERGER, M.D.
University of Louisville

Alveolar Cell Tumors of the Lung. C. Allen Good, John R. McDonald, O. Theron Clagett, and Eugene R. Griffith. Am. J. Roentgenol. **64:** 1–18, July 1950.

Alveolar-cell tumor of the lung is a rare neoplasm which is progressive and will ultimately cause the death of the patient by suffocation or by involvement of distant organs.

From a study of the cases presented by the authors, it would seem that the earliest form of involvement is a small, poorly defined area of consolidation similar to the pneumonitis seen following bronchial obstruction or in conjunction with atypical pneumonia. As the disease progresses, it may involve more and more of the lung until the entire lobe is affected. With further development, other centers of involvement become apparent either in the same lobe, in the same lung, or in the opposite lung. Whether this indicates a multicentric origin or secondary centers of activity cannot be stated definitely. Certainly in the advanced stages both lungs are involved with multiple foci. These nodules frequently become confluent and may give the appearance of a mass or of a consolidated lobe. During this stage of the disease, the involved portions of the lung are relatively airless, and the patients usually exhibit marked dyspnea and even cyanosis.

There is nothing in the appearance of the roentgenogram of the thorax in the 12 cases in this series which allows a definite diagnosis of alveolar-cell carcinoma. In the earlier stages the lesion may be confused with pulmonary abscess, with bronchiectasis, or with chronic pneumonitis secondary to bronchial obstruction from any cause. Because of the age at which the lesions are encountered, bronchogenic carcinoma will always be one of the possibilities considered. When the involvement is bilateral and diffuse, a metastatic malignant lesion, the diffuse granulomas (such as tuberculosis, sarcoidosis, and those caused by various fungi), and pneumoconiosis will be considered in the differential diagnosis.

Although bronchoscopic examination is seldom of value in identifying the lesion, material obtained through the bronchoscope, either as tissue for biopsy or as secretions from the bronchial tree, may, when examined microscopically, enable one to establish a definite diagnosis.

The most valuable single aid in diagnosis is the cytologic examination of sputum or bronchial secretions. In the majority of instances this examination should indicate that a neoplastic process is present in the lungs, and on some occasions it may even offer a definite diagnosis of alveolar-cell tumor.

Although the clinical features may be helpful when typical sputum is present in conjunction with cough and dyspnea, the history may be no different from that obtained from patients with other types of pulmonary disease. Cough is a prominent feature and hemoptysis is frequent. Loss of weight may or may not occur.

Surgery offers the only effective treatment which is

known at the present time. It is indicated whenever the lesion is localized to one lung or one lobe of the lung. Although it is too early to draw conclusions and the material which forms the basis of this report is too small, it would seem that pulmonary resection may at least alleviate the symptoms and may even offer hope for a cure. Further study and observation of cases will decide whether or not lasting cures can be obtained.

Fifteen roentgenograms; 2 photographs, 7 photomicrographs. DANIEL WILNER, M.D.
Atlantic City, N. J.

Bilateral Involvement and Unusual Types of Penetration by Pancoast or Eruption Forms of Bronchial Carcinoma. Rudolf Birkner and Max Brandt. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 641–653, April 1950. (In German)

The authors describe in detail three cases of Pancoast tumor which, in their opinion, must be regarded as only a specially localized form of the many possible "eruption types" of bronchial carcinoma. The most characteristic feature of the "eruption tumors" is their penetration in a peripheral direction, which may "burst" the thoracic wall. While any of the osseous structures of the thorax may be involved, penetration, without bone destruction, through the costal interspaces is also possible. The so-called "endothelioma of the pleura" (which, according to some pathologists, is a doubtful entity) may in reality represent an "eruption type" of bronchial carcinoma.

The authors' first case was seen in a 64-year old metal worker with a tumor in the left apex and the right middle third; the pathologic process extended into the left first and the right third rib. Pain in the left shoulder and cachexia were the outstanding symptoms. In view of the advanced stage of the disease, radiotherapy or other therapeutic measures appeared contraindicated, and the patient died soon after establishment of the diagnosis.

The second patient, a 64-year old asphalt and tar worker with tumor invasion of the sternum, received irradiation and was still alive at the time of the report.

The third case was observed in a 34-year old housewife. The radiologic examination suggested carcinoma of the bronchus of the left upper lobe with extension to the soft tissues of the thoracic wall without bone involvement, and this diagnosis was confirmed at autopsy. Metastatic nodes were present in the hilar, paratracheal, and cervical lymph nodes. Rapid cachexia ensued and the patient died without radiotherapy.

It is suggested that in the first two cases chronic lesions, due respectively to iron oxide and tar products, may have predisposed to the unusual eruption type of carcinoma. Old pulmonary or pleural scars, which have been held responsible by some investigators for the particular direction of the tumor growth in similar cases, could not be demonstrated in the authors' patients.

Six roentgenograms; 6 photomicrographs; 2 photographs. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Boeck's Lung Disease (Lymphogranulomatosis benigna pulmonum). Helmut Hartweg. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 385–408, February 1950. (In German)

Boeck's disease is not rare. According to Burger and Kuethe (Geneesk. bl. u. klin. en lab. v. d. prakt. **37:** 1, 1939), in a town of 35,000 inhabitants 39 cases were found by mass fluoroscopy. The disease can be without symptoms for many years, and there is no doubt that patients have been separated from their families unjustly, with a diagnosis of tuberculosis. One patient in the author's series had spent four years and a half in a tuberculosis sanatorium.

The etiology of Boeck's sarcoid is still unknown. Most scientists believe the cause may be a virus or a general infection closely related to tuberculosis.

Hartweg reports in detail a series of 57 cases which were seen in a period of seven years. According to his observations, the three stages of the disease described by Gravesen (Zentralbl. f. d. ges. Tuberk.-Forsch. **55:** 489, 1943) are inadequate, and fourth and fifth stages should be added.

The first stage is characterized by hilar enlargement, which at the onset may be unilateral. The second stage develops after weeks, months, or even years and is demonstrable in the roentgenogram as a fine reticular network, with many nodes of various sizes. Usually, after weeks or months, this miliary infiltration disappears and is followed by the third stage, a generalized fibrosis, which is very difficult to distinguish from a fibrotic tuberculosis. An extensive induration and infiltration may develop from the purely fibrotic stage, constituting stage four, while stage five includes cases in which there is a predominance of thick nodular and confluent infiltrations (Knotenlunge), containing nodes of fibrotic and indurative sarcoid tissue. It is not known whether patients in stage five can survive. Usually they succumb to right heart failure.

The differential diagnosis of Boeck's sarcoid of the lungs in relation to the different stages is discussed in detail.

Thirty-one roentgenograms; 1 photograph; 1 photomicrograph. EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Cysts of the Lung and of the Mediastinum. J. B. Jobin. Canad. M. A. J. **63:** 48–52, July 1950.

Mediastinal cysts are almost always congenital in origin, whereas those of the lung may be acquired. The pulmonary cyst may be found anywhere in the parenchyma of the lung, but is more often located in the hilus. Mediastinal cysts are present with decreasing frequency around the pulmonary hilus, the trachea, the carinal region, the esophagus, the spine, and the pericardium. Whether bronchogenic, digestive, dermoid or hydatid, the mediastinal cyst is always filled with liquid and is therefore radiopaque. Cysts of the lung may also be filled with liquid (if they do not communicate with the bronchi), with liquid and air, or with air alone.

The roentgen findings are very important in revealing the presence of a cyst, as clinical signs are often absent. It is not exceptional for a cyst to be found during routine examination. Whatever the type of cyst, the image is opaque, rounded, and with perfectly sharp edges. In the dermoid cyst, shadows of varying opacity may be observed. With a cyst opening into a bronchus, a cavity with fluid level and very thin walls is usually seen in the parenchyma of the lung, with normal transparency. Fibrous bands sometimes cross the cavity.

A cyst must be differentiated from thymic tumor, aneurysm, a neurogenic tumor, or any other solid tumor of the mediastinum. The thymic tumor is less sharp,

extending beyond the mediastinum and protruding over the clavicle. Aneurysm is characterized by pulsation and can also be detected by angiocardiography. The neurogenic tumor is located posteriorly in the costovertebral hollow, whereas the cyst remains in front of the spine. Solid tumors of the mediastinum do not generally show a sharp-edged image, and the limits are often not clearly determined. Pneumocysts and cystic bronchiectasis give clear rounded shadows with very thin walls.

Six cases of bronchogenic cyst are reported, 4 pulmonary and 2 mediastinal. A seventh case, of cystic dilatation of the bronchi, is also presented. Five of the bronchogenic cysts were located on the right side. The diagnosis in 3 of the patients was purely incidental. Five of the patients were operated upon; 1 died shortly after the operation.

Six roentgenograms.

Pathogenesis of Chronic Substantial (Hypertrophic) Emphysema. Felix G. Fleischner. Am. Rev. Tuberc. **62:** 45–57, July 1950 (Part 1).

Chronic hypertrophic emphysema is the common type which occurs most frequently in males and is found in 2 to 5 per cent of all autopsies. The author suggests the term "generalized peripheral obstructive emphysema," since there is actually atrophy of the structures, which makes the term "hypertrophic" misleading. This designation would also serve for differentiation from the localized form of emphysema due to obstruction of large bronchi.

Structural emphysema and clinical emphysema are two distinct though related conditions, and emphysema of the lungs is always a secondary manifestation of other primary diseases of the lung, bronchi, pleura, heart, or chest. Failure to understand the above statement has led to persistent confusion regarding the pathogenesis and diagnosis of emphysema. Many theories have been advanced, with that based on bronchial obstruction having the most advocates. The theory that hypertrophic emphysema is a special instance of compensatory emphysema is the most tenable according to the author. The degree of bronchiolar obstruction in any given area of the lung is variable at any one time, and the less obstructed alveoli will tend to overdistend; eventually the majority of the bronchioles will have been more or less obstructed and the majority of the alveoli will have been overdistended. This theory explains the close anatomic arrangement of atelectasis and emphysema and also the absence of bronchial stricture or obstruction in hypertrophic emphysema.

The expansibility and resilience of the lung are provided by its structural elasticity, the resilience of the thoracic and abdominal wall, gravity, and surface tension at the moist alveolar surfaces. Patency of the bronchial system is also necessary. It has been shown, by means of bronchograms taken in inspiration and expiration, that the bronchi are increased in both length and diameter during inspiration and that there is a decrease in expiration. Under normal conditions, a longer duration of expiration compensates for the delay in evacuation of the lungs because of the above differences during the respiratory phases. Abnormal narrowing in itself acts as a valve to prevent normal egress and promote retention of air. In addition, in bronchograms the oil lines the bronchial walls in a thin film during inspiration, while in expiration there is a tendency to droplet formation, resulting in some degree of obstruction and air-pocket formation. This means that secretions, which are usually increased in asthma and bronchitis, very likely add to the ball-valve effect to tend to increase the intra-alveolar pressure.

The expiratory obstruction, postulated as the causative functional factor in emphysema, can therefore be visually demonstrated. Furthermore, this obstructive factor can be present with preservation of anatomic patency of the smaller bronchi and alveolar infundibula.

JOHN H. JUHL, M.D.
University of Wisconsin

On the Occurrence of a Left-Sided Vena Azygos Lobe. Egon Schmitz-Cliever. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 728–731, April 1950. (In German)

The occurrence of a vena azygos lobe in the left lung is so rare that its existence has been seriously doubted by many investigators. Only 3 definitely proved cases have been reported in the medical literature. The author adds a case of his own observation, confirmed by tomography, in a 22-year-old female x-ray technician. There were no symptoms, and no other abnormalities were present. According to Křivinka (Röntgenpraxis **11:** 234, 1939), the left-sided vena azygos lobe may be explained either by transposition of the azygos vessels or by paired development.

Three roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Disseminated Pulmonary Calcification. A Report of 114 Cases with Observations of an Antecedent Pulmonary Disease in 15 Individuals. F. Clark White and Harry E. Hill. Am. Rev. Tuberc. **62:** 1–16, July 1950 (Part 1).

A study of 114 patients with disseminated pulmonary calcifications is reported. Fifteen of the series were followed from the onset of chronic pulmonary disease to the development of calcifications. Histoplasmin sensitivity was found in 94 per cent and tuberculin sensitivity in 52.4 per cent of 84 patients with calcification in contrast to a 14.2 per cent sensitivity to the former and 29.8 per cent to the latter in a total of 305 controls who lived in the same section of upstate New York. In 12 of the 15 cases in which the mode of onset was established, exposure to excessive concentrations of organic dust immediately preceded the initial symptoms. Widespread abnormal densities preceded the development of calcifications by periods ranging from eight to thirty months. These densities became smaller and more discrete as they progressed toward calcification. The process did not become complete in ten years in the majority of cases.

Symptoms at the onset consisted of varying degrees of cough, chest pain, fever, sweating, weakness, and debility. Histopathologic study was done on one patient who was accidentally killed. The pulmonary nodules consisted of a central core of eosinophilic amorphous material surrounded by a ring of coarse granular calcium deposit. This was encased in a dense hyalinized fibrous tissue. There was no inflammatory reaction in the area.

The authors discuss the various etiologic agents which have been previously reported as causes of miliary pulmonary calcifications. Because of the high incidence of histoplasmin sensitivity found by them and by other authors, they feel that *Histoplasma capsulatum*

or some antigenically related fungus is the likely agent and that it is probably dust-borne. The fact that the organism will grow in the saprophytic phase in soil containing humus is of interest, since it is possible that dust might naturally contain the organism under certain conditions. It is still uncertain, however, whether dust containing these spores will infect animals or man.

JOHN H. JUHL, M.D.
University of Wisconsin

Latent Silicosis. M. McQuitty, B. Cuddihy, C. A. MacIntosh, and G. T. Adams. Canad. M. A. J. **63:** 69–70, July 1950.

The authors present an interesting case of silicosis, illustrating the development of radiographic evidence of the disease following a normal chest roentgenogram at the time of separation from employment in a dusty atmosphere.

The patient enlisted in the army at the age of thirty-one. For four years prior to enlistment he had worked as a handyman in a small foundry where enamel signs were made. (It is pointed out that in many foundries there are dangerous concentrations of silica dust and that sandblasting in the manufacture of enamel signs may also involve exposure to such dust.) An enlistment chest film was negative (1940), but five years later, on the patient's release from a German prison camp, a roentgenogram showed a characteristic picture of silicosis.

This late development of silicosis has been observed more frequently than might be expected.

The authors suggest that yearly chest roentgenograms should be obtained by workers following separation from any employment which involves a significant exposure to silica dust and that before a workman leaves such employment he should make a claim for possible silicosis, for compensation purposes.

Three roentgenograms.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Further Observations on the Pathological Physiology of Chronic Pulmonary Granulomatosis Associated with Beryllium Workers. Robert A. Bruce, Frank W. Lovejoy, Jr., Paul N. G. Yu, Raymond Pearson, and Marion McDowell. Am. Rev. Tuberc. **62:** 29–44, July 1950 (Part I).

In a preliminary report the authors found that there was a widening of the alveolar-arterial gradient for oxygen in chronic pulmonary granulomatosis caused by beryllium (Am. Rev. Tuberc. **59:** 364, 1949. Abst. in Radiology **54:** 450, 1950). This was due to alterations in the structure and volume of the lungs which impaired the distribution and diffusion of respiratory gases. The present study was made on three additional patients who had been exposed to beryllium for periods ranging from two and a half to five years before the onset of symptoms.

Reduced complemental and total pulmonary capacities, increased oxygen gradient of the lungs, hypoxemia, and exertional hyperventilation were found in varying degrees in both groups of patients. A comprehensive evaluation of cardiorespiratory performance, the physical fitness index, showed great impairment and was considered to be a good quantitative test of the amount of decrease in capacity for moderate work. The changes noted are non-specific and resemble those found in pulmonary fibrosis from other causes, but not those seen in emphysema.

In the course of the study of the effect of continuous oxygen therapy in these patients, it was found that the vital capacity and residual air volume were decreased by the procedure. Following the cessation of oxygen treatment, the patient experienced a severe relapse, with intense dyspnea, anorexia, nausea, weakness, depression, and irritability. These withdrawal symptoms gradually decreased with a return to pretreatment levels of lung volume, arterial blood gas composition, ventilatory effort, and exercise tolerance. Similar studies were done on an emphysematous patient, but in this case lasting benefit was obtained by continuous oxygen therapy and there were no untoward withdrawal symptoms. The authors feel, therefore, that oxygen therapy can be used intermittently, but that its continuous use is definitely contraindicated in chronic pulmonary granulomatosis in beryllium workers.

JOHN H. JUHL, M.D.
University of Wisconsin

Concerning the Question of the Aluminum Lung. Karl Umbach. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 474–479, February 1950. (In German)

Only since the beginning of World War II has an increase in the number of cases of aluminum-dust poisoning of the lungs been observed in Germany. The condition is fatal in the majority of cases. It was recognized as a compensatory occupational disease by the German Industrial Commission, effective Jan. 29, 1943. Aluminum has been shown experimentally to have a tendency to form colloidal compounds, which are responsible for the tissue changes in the lungs. Kahlau (Frankfurt. Ztschr. f. Path. **55:** 364, 1941) has shown that the respiratory parenchyma undergoes a collagenous-hyaline degeneration followed by hardening and shrinking of the lung tissues. The formation of localized hyaline nodes is characteristic for the aluminum lung.

Roentgenograms of the chest reveal, in the beginning, a net-like or honeycomb accentuation of the bronchial markings, interwoven with small, soft, irregularly bordered nodules. Later roentgenograms show confluence. The changes are neither symmetrical nor bilateral. The clinical course is rapid, which distinguishes this condition from other types of pneumoconiosis. Predominant clinical features are severe shortness of breath and persistent cough.

Umbach describes a case in a 28-year-old male who suffered from a chronic bronchitis over a period of years. He was last employed for one year in an aluminum factory under bad working conditions, and was admitted to the hospital because of chronic bronchitis, shortness of breath, and occasional blood in the sputum. Therapy was symptomatic. The patient was unable to work after three years and died nine years after the first observation. There was no autopsy report.

Four roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Pulmonary Manifestations of Gasoline Intoxication. A Review with Report of a Case. Reuben Zucker, Edwin D. Kilbourne, and Joseph B. Evans. Arch. Indust. Hyg. & Occup. Med. **2:** 17–24, July 1950.

A case of pneumonitis developing in a 19-year-old soldier shortly after the aspiration of liquid gasoline is

reported. The initial symptoms after the accident—cough and a sense of suffocation—were followed seconds later by a momentary loss of consciousness, which was in turn followed by vomiting. Physical examination at this time disclosed no abnormality except that the patient was "apprehensive." About twelve hours after the accident, the pulse was 100, respirations 40, temperature 102.1° F. Examination now showed dullness to percussion with diminished breath sounds in the right half of the chest from the seventh rib posteriorly and the fourth rib anteriorly to the base. There was also tenderness to palpation in the right upper abdominal quadrant. A roentgenogram of the chest revealed lobar consolidation of the middle and lower lobes of the right lung with infiltration of the left lower lung field. The patient was placed in an oxygen tent, and penicillin was given intramuscularly. During the night the temperature rose to 102.6° F. and the pulse to 118, and there was complaint of pain in the left chest. An electrocardiogram taken on the second day following the accident showed no evidence of myocardial damage or conduction defect. The removal of a small amount of fluid from the pleural space gave some relief from dyspnea. Roentgen examination of the chest on the third day showed both leaves of the diaphragm to be obscured. By the fifth day some evidence of clearing was visible in both lung fields; four weeks after the accident the lungs were clear except for residual heavy basilar markings.

A novel feature of this case was the finding of temporary first degree heart block three weeks after the onset of illness. Serial electrocardiograms had not been taken because of the absence of clinical evidence of carditis and because the electrocardiogram on the second day of illness showed normal conduction. The significance of this finding is debatable, but the authors suggest that a protoplasmic poison capable of producing pneumonitis might cause myocardial damage as well.

Three roentgenograms; 1 table summarizing previously reported cases of gasoline intoxication following aspiration.

Recurrent Reversible Pulmonary Edema Following Nitrous Gas Intoxication. Wolfgang Hirsch. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 480–484, February 1950. (In German)

A 66-year-old male was admitted to the hospital with the history of having inhaled nitrous dioxide gas when a bottle of nitric acid had been accidentally emptied into a zinc pail, producing nitrous dioxide gases. Roentgen examination of the chest showed marked enlargement, increased density, and mottling of both hili, and extensive mottling in both lung fields, extending into the peripheries. A diagnosis of acute pulmonary edema was made. Four days later there was notable regression of the lesions and the lung fields appeared much clearer. On the fifth day, a recurrence of the acute edema was observed, and several weeks were required for its eventual disappearance. One year later, the patient was able to work and was without clinical symptoms.

The author believes that the lung changes were due to severe damage of the alveolar and bronchial epithelium.

Two roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Multiple Mercury Deposits in Roentgenogram of the Heart, Lungs and Spleen in a Case of Miliary Tuberculosis. Friedr. Ekert. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 470–473, February 1950. (In German)

The author describes an unusual finding in a female patient who was referred to him in 1944 because of a suspicion of pneumonia. In addition to evidence of lung congestion, the roentgenogram showed large numbers of small metallic shadows, round, with sharp borders, in the middle and lower lung field on both sides. The patient stated that about two years previously she had fallen into a container of mercury, suffered an open injury to the forearm, and lost a large amount of blood. Metal deposits in the soft tissues in this area made the unusual history plausible.

The patient died, and autopsy revealed mercury deposits in the right ventricle of the heart and a large number of small deposits in the lungs, spleen, and liver. In addition, there was evidence of miliary tuberculosis.

It is pointed out by the author that, according to reports in the literature, patients with chronic mercury poisoning are highly susceptible to tuberculosis. It is of general interest that large deposits of mercury can be tolerated without causing reactions in the surrounding tissues.

Six roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Diagnosis of Bronchial Stenosis. Harold A. Lyons. Dis. of Chest **18:** 16–26, July 1950.

The author discusses partial and complete bronchial obstruction and enumerates the causes as intrabronchial (impaction of an endogenous or exogenous body), endobronchial (intrinsic disease of the channel), and extrabronchial. Bronchial obstruction leads to physiological disturbances, which are dependent upon (1) the site of the obstruction; (2) its degree and character; (3) the time factor in the development of obstruction; (4) its cause; (5) the occurrence of infection in the surrounding lung; (6) the status of the pulmonary and systemic circulations.

In the presence of obstruction, the following symptoms are usually observed: wheeze, cough, thin frothy sputum (unless infection has supervened, in which event the sputum is purulent), and dyspnea on change of position. On physical examination, sibilant and sonorous rhonchi are audible at the end of forced expiration. Sometimes they are heard only when the patient is lying on the affected side.

The author stresses fluoroscopic and roentgenographic examinations, mentioning the mediastinal shift to the affected side in the presence of obstructive atelectasis, and to the opposite side in obstructive emphysema. Tomography and over-exposed films will help in localizing lesions. Bronchography is not ordinarily recommended because of infection, and also the possibility of aggravating the block. Bronchoscopy may localize the stenosis and disclose the character of the lesion.

Thirteen illustrations, including 8 roentgenograms; 2 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Bronchial Stenosis. Edgar Mayer and Israel Rappaport. Am. Rev. Tuberc. **62:** 80–89, July 1950 (Part II).

Two cases of bronchial stenosis are reported, one due to traumatic tear of a bronchus with complete oblitera-

tion of the lumen in the process of healing and the other due to a non-opaque foreign body.

The authors point out the absence of radiographic changes in the early cases, which can be detected by means of auscultation, fluoroscopy, and bronchoscopy. The most significant auscultatory finding is a localized wheeze which is inspiratory in the earliest stage and later is heard during expiration as well. As viscid secretions accumulate at the site of obstruction, coarse rhonchi, sibilant and sonorous and grunting noises may be heard. Signs of obstructive emphysema on the involved side can be demonstrated relatively early by fluoroscopy, while the actual lesion causing the obstruction may be seen bronchoscopically. Symptoms are cough, tending to become more productive as the obstruction progresses, mild dyspnea, chest discomfort, and occasionally blood-tinged sputum. Atelectasis and secondary infection accentuate these symptoms later in the course of the obstruction.

The authors present an etiologic classification of bronchial obstruction, dividing the causes into three main categories: endobronchial, intramural, and extrabronchial (compression), in addition to the intrinsic diseases of the bronchi in which generalized wheezing is present. In the last group are such diseases as bronchial asthma, allergic bronchitis, and pulmonary emphysema. In the localized form of bronchial obstruction, the most common causes are tuberculous bronchitis and pulmonary neoplasms.

Failure to recognize stenosis in an early stage results in many cases in irreparable damage to the lung; in others bronchogenic neoplasms may go unrecognized.

JOHN H. JUHL, M.D.
University of Wisconsin

Contribution to the Knowledge of Bronchographic Changes in Chronic Bronchitis. F. K. Fischer. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 653–659, April 1950. (In German)

In chronic purulent bronchitis there are frequently present inflammatory changes in the glands of the mucous membrane which escape detection by the usual bronchographic methods utilizing iodized oils. With a water-soluble iodine medium, as for instance Ioduron-B, enlargement of the diseased glandular ducts could frequently be shown. These pathologic changes are demonstrable as saccular or pointed protrusions most frequently situated over the lower margins of the affected bronchi.

Eight bronchograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Angiocardiography in Heart Disease in Children. Rodolfo O. Kreutzer, Juan A. Caprile, and Frederik M. Wessels. Brit. Heart J. **12:** 293–304, July 1950.

Eleven cases are reported in which angiocardiography was done. The series includes a normal case, agenesis of one lung, and a mediastinal cyst, as well as various cardiac anomalies.

The best results were obtained with diodone, 75 per cent solution, although the manufacturers do not recommend the medium for this purpose. The authors use 10 c.c. for a newborn infant, 12 c.c. for children up to three months, 15 c.c. up to one year, and from then on 1.5 c.c. per kilogram of body weight. Percutaneous injection is done, with only local anesthesia. The films are taken at intervals of one second, usually in the left anterior oblique position. A single fatality resulted in over 400 examinations.

The reproductions are quite good and each is accompanied by an explanatory drawing. Anyone interested in angiocardiography in children should see this article.

Fourteen roentgenograms; 14 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Angiocardiography. Anatomo-Roentgenological Forms of the Transposition of the Great Vessels. Agustin Castellanos, Raul Pereiras, and Otto Garcia. Am. J. Roentgenol. **64:** 255–264, August 1950.

The authors base their study of transposition of the great vessels on 7 cases in which angiocardiography was done, 3 of which came to autopsy. They feel very strongly that the cardiac outline is of no value in the diagnosis of this condition, since it is dependent upon the diameter, situation, and direction of the aorta and pulmonary artery, which are themselves subject to anatomical variation.

Angiocardiography shows with extraordinary accuracy whether the aorta arises from the right or left ventricle, or overriding the septum. It indicates, also, whether the pulmonary artery arises with the aorta at the right ventricle or at the left ventricle. For these reasons the procedure is considered the best method for diagnosis of transposition of the great vessels. At the same time, it gives an opportunity for making a practical classification of an anatomical nature.

Four types of transposition are recognized:

1. The aorta arises forward and toward the right of the pulmonary artery. The arch ascends to the left and backward and lies normally over the left bronchus. The pulmonary artery is situated at the left heart border and is usually diminished in caliber. The vascular pedicle is of normal width or slightly widened.

2. This type is similar to Type 1, but the aorta arises in the midline and ascends slightly to the left. The pulmonary artery and its branches are not seen in the anteroposterior view. What happens to the "vascular pedicle" is not stated.

3. The aorta arises slightly or completely to the left of the midline, rising vertically and then bending to the right to form the arch, and descending in the posterior mediastinum, always at the left. The pulmonary artery is found always to the right of the aorta, and posterior to it, at times to the right of the midline. The cardiac outline shows a normal right border, but above the normal "left ventricular arch" there is a prominent mid-arch with all the characteristics of a pronounced pulmonary arch, or a high long convex arch reaching the superior mediastinum. The pulmonary artery is not demonstrable.

4. The aorta arises to the left of the midline, in antero-inferior position. It then ascends, behind and to the right, crossing the midline diagonally to reach the superior mediastinum, where it bends to form an arch enclosing the right major bronchus. It descends either to the right or the left of the midline. The pulmonary artery lies behind the aorta and to the right. Neither the main artery or its branches are shown in the angiocardiograms.

Ten angiocardiograms; 12 line drawings; 2 photographs.

I. R. BERGER, M.D.
University of Louisville

Angiocardiography: The Prominent Pulmonary Artery Segment. J. E. Miller. Am. J. Roentgenol. **64:** 214–220, August 1950.

The author reviewed 200 angiocardiographic studies and failed to find a single instance in which the pulmonary conus—that portion of the right ventricle just below the pulmonic valves—formed a portion of the left heart border. The bulge along the left heart border just below the aorta is formed by the pulmonary artery and its branches. When this segment is prominent it may be termed the "prominent pulmonary artery segment." Such a finding is present in six conditions.

Idiopathic Dilatation of the Pulmonary Artery: This is pulmonary artery enlargement without demonstrable cause. The usual diagnosis in such patients is tuberculous hilar adenopathy or bronchogenic carcinoma.

Pulmonary Artery Aneurysm: When the pulmonary artery reaches aneurysmal proportions, this name is appropriate. The author did not find any of his 6 cases of pulmonary artery aneurysm to be of syphilitic origin.

Patent Ductus Arteriosus: Fifty per cent of cases with this congenital anomaly will present an enlarged pulmonary artery. Hilar dance is present in only 10 per cent of cases.

Interatrial Septal Defect: This usually causes a large pulmonary artery segment, along with enlargement of the right atrium and right ventricle. Hilar dance is a constant finding.

Eisenmenger's Complex: Here the pulmonary artery may be of normal size or may show post-stenotic dilatation. Patients with post-stenotic dilatation may show a marked hilar dance.

Post-Stenotic Dilatation: Seven cases of isolated post-stenotic dilatation were seen. Here there is disproportionate enlargement of the heart to the right of the spine. The pulmonary artery is usually high and obscures the aortic knob.

Eighteen roentgenograms. I. R. BERGER, M.D.
University of Louisville

Arteriography of the Aorta and Its Branches by Means of the Polyethylene Catheter. James A. Helmsworth, Johnson McGuire, and Benjamin Felson. Am. J. Roentgenol. **64:** 196–213, August 1950.

The authors describe in rather full detail the technical, clinical, and roentgen aspects of catheterization of the aorta with polyethylene catheters. The procedure was used in 24 cases and 11 of these are presented.

The catheters used are of three sizes, varying in internal diameter from 0.045 to 0.096 inches and in external diameter from 0.067 to 0.146 inches. The arteries are incised under direct vision and the catheters inserted using the brachial, ulnar collateral, and femoral arteries as the case requires. When the left side was used, the catheter failed to enter the aorta in 2 to 5 instances. Visualization of the coronary arteries (in 2 of 6 cases), of the thoracic and abdominal aorta, the innominate and internal carotid arteries and their branches was obtained. From one to as many as six injections of neoiopax (75 per cent) or diodrast (70 per cent) were used.

One death, in a patient already moribund, was attributed to the procedure, and in 2 other cases significant reactions occurred. Among the pathologic states demonstrated were aneurysms of thoracic and abdominal aorta, aneurysm of innominate artery, cervical arteriovenous aneurysm, and in one case displacement of intracranial vessels by meningioma. Coarctation of the aorta was nicely shown in one instance.

Eighteen roentgenograms; 17 line drawings.
I. R. BERGER, M.D.
University of Louisville

Thoracic Aortography in the Diagnosis of Patent Ductus Arteriosus Botalli. Bror Brodén, Gunnar Jönsson, and Johan Karnell. Acta radiol. **34:** 65–81, July-August 1950.

Thoracic aortography was used in 14 adults and 3 children for the diagnosis of patent ductus arteriosus. In 3 cases, with atypical murmur and inconclusive clinical findings, the diagnosis could be established only by this means. Not only was the procedure of aid in diagnosis of the presence and site of the anomaly, but it permitted accurate estimation of the length and width of the ductus in the majority of cases.

The authors give a brief résumé of the anatomy, pathophysiology, and clinical diagnosis of patent ductus arteriosus. The most characteristic clinical sign is the continuous murmur produced by the flow of blood through the ductus. The differential diagnosis is difficult, for the clinical findings vary, and other conditions may produce a similar picture. Routine roentgen examination reveals only secondary anatomic changes which are not pathognomonic. Angiocardiography is an unsuitable method for investigating a patent ductus arteriosus because the contrast medium in the pulmonary artery becomes too dilute when it is shunted through the ductus. Opacification of the pulmonary artery and the anomalous component, therefore, is usually insufficient for definite conclusion.

Thoracic aortography was accomplished by injecting rapidly, usually through a heart catheter, but occasionally through a cannula, 50 to 80 c.c. of 50 to 70 per cent diodrast (or umbradil). Anteroposterior and lateral films were made at the rate of one per second. [For the technic, see Absts. in Radiology **52:** 139, 1949; **54:** 779, 1950; **55:** 616, 1950.]

In all adult cases, passage of contrast material from the aorta to the pulmonary artery was demonstrated and the interarterial communication was shown to be a patent ductus arteriosus. In 6 cases, the ductus was so clearly opacified that its width could be estimated, and in 4 of these its length was also distinguishable. These estimates were proved at operation to be relatively accurate. Localized dilatation of the aorta around the base of the ductus was clearly seen in 7 and was suspected in 4 cases.

Comparable findings were observed in 2 of the 3 children with later proved patent ductus arteriosus. It may be difficult in children to insert through a peripheral artery a catheter large enough to permit rapid injection, which is necessary to provide sufficient concentration of the contrast substance for visualization. This factor may prevent satisfactory aortographic examination in young patients.

The authors believe that even though there is no absolute indication for thoracic aortography in clinically established cases, it is necessary to insure diagnosis in cases of patent ductus arteriosus with an atypical murmur. In addition, it often provides valuable information regarding the anatomy of the defect when surgical intervention is being planned.

Thirteen aortograms; 1 drawing; 1 table.
RICHARD A. SILVER, M.D.
Indiana University

THE DIGESTIVE SYSTEM

Esophagitis. Alfred Vogt. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 686–691, April 1950. (In German)

Three cases of esophagitis are reported: one in a patient suffering from lymphosarcomatosis, one in lymphatic leukemia, and the third associated with peptic ulcer of the esophagus. The radiographic signs consisted in coarseness and irregularity of the mucosal pattern which reached ulceration and serration in the more advanced stages. Examination by means of the ordinary thin barium mixture, with the patient recumbent, is recommended as superior to the usual examination with a thick barium mixture in the erect position.

Seven roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Diagnostic Problems of Gross Hemorrhage from the Upper Gastro-Intestinal Tract. Henry J. Tumen. Pennsylvania M. J. **53:** 713–721, July 1950.

Gross hemorrhage from the gastro-intestinal tract is a dramatic emergency that calls for prompt action on the part of the physician even though he does not know the cause of the bleeding. Peptic ulcer, gastritis, and esophageal varices due to cirrhosis of the liver cause over 80 per cent of gross hemorrhage. Among the other causes are hiatus hernia, benign and malignant gastric tumors, and more rarely blood dyscrasias.

A detailed history is the first requirement in an attempt to establish a diagnosis, but in many cases there is no antecedent history to serve as a guide, and the massive hemorrhage is the first sign of disease. A history of recurrent pain following meals, with food and antacid relief, goes far toward indicating an ulcer as responsible for the bleeding, though 25 per cent of patients with hemorrhage from this cause have no typical ulcer distress. A history of repeated hemorrhages over a period of years is most commonly indicative of gastritis. Gross hemorrhage due to cancer occurs, as a rule, only in an advanced stage of the disease, but with a benign tumor the cycle of ulceration, hemorrhage, and healing may be repeated many times. Cirrhosis may cause repeated bouts of bleeding, but experience indicates that 70 per cent of patients with cirrhosis will die within a year after the first hemorrhage.

Physical examination is seldom very revealing, although occasionally an epigastric mass, large nodes in the axilla, or a palpable rectal shelf are found in gastric cancer. Enlargement of the spleen or lymph nodes or the finding of purpuric areas or bleeding from the gums is suggestive of a blood dyscrasia. Bleeding from esophageal varices rarely occurs early in cirrhosis, and the physical signs are usually present at the time of hemorrhage. A slight jaundice, ascites, splenomegaly, angiomata, or a definite collateral circulation should be sought in these cases.

Detailed hematologic studies should be made in cases of blood dyscrasias. Gastric analysis is not to be carried out until all danger of hemorrhage has passed. Its only value is to suggest cancer when there is lack of gastric acid. Bromsulfalein retention is fairly conclusive evidence of advanced liver disease.

X-ray examination of the upper gastro-intestinal tract is the most reliable means of demonstrating a lesion or excluding its presence. In the past it was the custom to wait for two or three weeks after the hemorrhage had subsided before undertaking a roentgen study, but later the practice has been to attempt it after the bleeding has ceased or even as soon as the patient has recovered from shock. It is true that there is some danger of exciting another hemorrhage in doing an examination so early, but with a minimum of palpation, with no turning, and with spot filming, untoward results will seldom be encountered. Errors in diagnosis are sure to be high with this procedure because of the restrictions imposed upon the radiologist, and the fact that a blood clot may hide the ulcer that is sought. A large clot may also simulate a filling defect and lead to a false diagnosis. Repeated x-ray examinations should be done, therefore, if the findings are not definite. If repeated attempts to find a lesion fail, small bowel studies are indicated, although small bowel tumors are only rarely the cause of massive hemorrhage.

Esophagoscopy is usually neither advisable or necessary but gastroscopy may be helpful if performed soon after hemorrhage. It is chiefly of value in showing the presence of gastritis and in hemorrhage from a paraesophageal hernia. It should be carried out only on patients who have been thoroughly studied by x-ray examination, and requires great caution.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

Early Roentgen Diagnosis of Cancer of the Stomach. M. Lüdin. Radiol. clin. **19:** 193–205, July 1950. (In German)

In this paper, the early radiologic diagnosis of cancer of the stomach is discussed and well illustrated. All cases should be studied thoroughly under the fluoroscope with the patient in various positions. Any lack of normal peristalsis may mean early infiltration of the stomach wall. It is also of vital importance to study the mucosal pattern. Serial views are necessary for an early diagnosis, though often regarded as a waste of money, material, and time by non-radiologists.

To demonstrate early cancer of the cardia and fornix Lüdin uses the technic of Jutras to demonstrate the cardia and the mucous folds in that area. This is done in the Trendelenburg position, with spot films. The most frequent differential problem in this region is presented by varicosities. To estimate the thickness of the stomach wall, it is helpful to increase the size of the gas bubble of the stomach by using carbon dioxide. With the progress in surgery which makes it possible to remove these high-seated neoplasms, the responsibility of the radiologist for their early diagnosis has increased.

In the lesions of the midportion of the stomach, the question of malignant degeneration of an ulcer is the most difficult to decide. There are no reliable characteristics of early malignant change. Lüdin is opposed to waiting and rechecking, holding that immediate surgical intervention is indicated if there is the slightest suspicion. The differential diagnosis of gastritis, inflammatory tumors, lymphatic infiltrations, and polyposis is discussed and explained.

Seventy-five per cent of all cancers of the stomach are in the prepyloric region. The study of the course of the mucous folds is important in this area. Relaxation of the pylorus has been accomplished by giving 0.01 gm. of morphine.

Twenty-seven roentgenogroms; 3 photographs.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Two Cases of Schwannoma of the Stomach. P. Anex. Radiol. clin. **19:** 206–209, July 1950. (In French)

Approximately 1 per cent of the tumors occurring in the stomach are benign. The first benign gastric tumor to be recorded was a lipoma, described by Cruveilhier; the latest is the schwannoma (neurofibroma), which was reported by Leriche in 1911. Two cases of this latter lesion are presented here.

The schwannoma is an encapsulated tumor, well delineated, homogeneous, formed of fusiform cells with round nuclei, often disposed in whorls and palisades. These cells are derived from the elements of the sheath of Schwann and may undergo malignant transformation to form a glioma.

Symptomatology is not characteristic; clinical evolution is usually insidious. Radiologic exploration, with the aid of the barium meal followed by air insufflation, may reveal two types of appearance. The first is a lacunar image of round, regular contour, not altering the mucosal folds, not causing contractions of the gastric wall, and occurring most often on the anterior or posterior wall. A central crater may be seen. A less frequent appearance is that of a mobile, pedunculated mass.

In differential diagnosis one must consider rare cases of edema and polyps.

Three roentgenograms; 2 drawings.

CHARLES NICE, M.D.
University of Minnesota

Roentgenologic Manifestations of Healed Ulcerative Intestinal Tuberculosis. F. Böhm. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 675–686, April 1950. (In German)

Anatomically healed intestinal tuberculosis is characterized by fine superficial stellate deformities of the mucosa, larger patches covered with atypical polypoid epithelium, thickening and rigidity of the intestinal wall, longitudinal shrinkage (especially in colon) resulting in foreshortening of the lumen, and stenosis. Accordingly, there is roentgen evidence of coarseness and disturbance of the normal mucosal contours, formation of areas of granular appearance, localized rigidity and unevenness of the intestinal wall. The foreshortening of the colon is accompanied by delay in the passage of barium. A characteristic picture is occasionally furnished by pouch formation of the cecum.

As intestinal tuberculosis may occur and heal without definite symptoms or diagnosis, radiologic recognition of such changes and consequent evaluation of the patient's condition may be of considerable clinical significance.

Twelve roentgenograms; 5 photographs.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

X-Ray Symptoms of Internal Biliary Fistulae. Walter Uhlmann. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 691–695, April 1950. (In German)

So-called internal biliary fistulae, *i.e.*, spontaneous communications between the biliary system and the neighboring organs, are rare. Roth, Schroeder, and Schloth are quoted as having found only 43 internal biliary fistulae in 11,000 autopsies, including 1 between the gallbladder and stomach, 19 between the gallbladder and duodenum, 5 between the choledochus and duodenum, 16 between the gallbladder and colon.

The most common cause of biliary fistulae is necrotizing inflammation of the gallbladder wall in cholelithiasis, with secondary inflammation of the serosa, adhesions with the gastro-intestinal tract, and subsequent perforation. The diagnosis *in vivo* is possible only by x-ray examination and is dependent on the demonstration of air in the biliary passages or on barium penetration into the biliary system during examination of the gastro-intestinal tract.

A rare case of internal biliary fistula following parapyloric ulceration of the stomach is presented. The roentgenograms showed extensive barium and air filling of the bile ducts proceeding from the ulcer niche. Cholecystography showed gas filling of the gallbladder without dye visualization. The diagnosis was confirmed at autopsy.

Three roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Demonstration of Gallstones After Intravenous Urography. H. Schoen. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 738–739, April 1950. (In German)

A case of cholelithiasis is reported in which intravenous pyelography (with perabrodil) resulted in the demonstration of the gallbladder and gallstones. A similar case reported by Rees at a meeting of roentgenologists in Stuttgart (Jan. 28, 1950) is mentioned. The possibilities of secretion of the pyelographic medium *via* liver and gallbladder are very briefly discussed.

Two roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

THE MUSCULOSKELETAL SYSTEM

Hereditary Polytopic Endochondral Dysostoses. Umberto Cocchi. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 409–435, February 1950. (In German)

The name "hereditary polytopic endochondral dysostosis" designates a group of diseases with numerous symmetric disturbances of the cartilage in the region of the epiphyses or epiphyseal lines. Clinically they are characterized by dwarfism, motor disturbance of the muscular system, marked deformity of the thorax and extremities, and sometimes changes in the cornea.

Of a total of 340 cases mentioned in the literature, Cocchi was able to study 305 thoroughly, and adds one of his own (Type, Pfaundler-Hurler), which was followed over a period of twenty-two years. These dysostoses have been described in the literature under many different names. Eighteen are mentioned in this paper, such as Kaschin-Beck's disease, partial achondroplasia, dysostosis multiplex, gargoylism, Morquio's disease, etc.

The author comes to the conclusion that there are three distinct types:

(1) Polytopic endochondral dysostosis with dominant heredity, without corneal opacity (Type Léri).

(2) Polytopic endochondral dysostosis with recessive heredity, without corneal opacity (Type Morquio).

(3) Polytopic endochondral dysostosis with recessive heredity and with corneal opacity (Type Pfaundler-Hurler).

The clinical and roentgenologic findings in these three groups are tabulated.

The diagnosis can properly be made only from a study of the family history and the hereditary background, together with a thorough clinical and roentgenologic examination.

Thirty-six illustrations, including 19 roentgenograms; 4 tables.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Osseous Changes in Neural Leprosy. Radiological Findings. James Barnetson. Acta radiol. **34:** 47–56, July-August 1950.

This is a well illustrated report on the radiological features of osseous changes occurring in the hands and feet of 107 patients with neural leprosy, observed in South Africa. Cases are classified as "early" when external deformity was slight or absent and "advanced," showing moderate or marked external deformity.

In the early group duration of symptoms ranged from one to twenty years and the degree of anesthesia in hands and feet varied from almost none to complete. The earliest radiologic change was always a notching of the distal margin of the terminal tuft. Atrophy then progressed to a fraying of the bone margins, flattening of the tuft, or "slicing off" of a lateral margin. Loss of substance occurred in all dimensions until the entire phalanx was absorbed. The process then continued in the more proximal phalanges. The changes were usually bilateral but not symmetrical, and the atrophy was more pronounced in the feet than in the hands. No definite diffuse osteoporosis was seen.

In the advanced group, symptoms had been present from two to thirty-three years and anesthesia was complete in both hands and feet in nearly all cases. The changes were a slow proximal continuation of the atrophy, without periosteal reaction, osteosclerosis, or sequestration unless secondary infections were present. Diffuse osteoporosis was seen in only 5 of 63 cases in this group. Whole digits were absorbed by the atrophic process, and metatarsals (but rarely metacarpals) were next involved. Trauma and infection accounted for more destruction in the feet than in the hands, and joints were involved usually only when there was associated trauma or infection.

Thirty-three roentgenograms; 1 table of clinical findings.

[See also following abstract.]

D. E. VIVIAN, M.D.
Indiana University

Osseous Changes in Neural Leprosy. Correlation between Histopathological and Radiological Findings. James Barnetson. Acta radiol. **34:** 57–64, July-August 1950.

The author, whose paper on the radiological aspects of osseous changes in neural leprosy is abstracted above, here reports an investigation of the histologic changes in bones showing roentgen evidence of the disease. Five cases are reported.

The changes observed in histologic preparations of the involved bones included fraying of the distal ends of the terminal phalanges, concentric atrophy of the phalanges, various other deformities, and diffuse osteoporosis.

The histologic sections of normal phalanges may occasionally reveal small gaps in the cortical bone, filled with connective tissue. In early neural leprosy, the first change appeared to be enlargement and increase in the number of these gaps, particularly along the distal margins of the phalanges. The gaps are filled with connective tissue continuous with the marrow and periosteum. In later cases, with gross deformities, if no roentgen evidence of osteoporosis exists, the cortical bone remains dense and of normal width up to the distal margins of the bone. When there is evidence of osteoporosis the cortex is narrowed and there is usually evidence of osteoclastic activity. When concentric atrophy is present, the cancellous bone undergoes absorption and the marrow cavity is narrow, but the cortical bone remains intact.

It is surprising that osteoclastic absorption of bone cannot always be detected. This is presumed to be because of the chronic nature of the process.

Five roentgenograms; 6 photomicrographs.

P. B. LOCKHART, M.D.
Indiana University

Osteosclerosis in Plasmocytoma. Report of a Case. Lorenz M. Kohler and Albert Laur. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 714–717, April 1950. (In German)

Though it is the general opinion that plasmocytoma (myeloma) produces only osteolytic bone changes and is not associated with osteosclerosis, the authors cite 4 instances of osteosclerosis among 179 cases of plasmocytoma reported in the medical literature and add one case of their own observation in a 65-year-old woman. The osteosclerotic changes in this latter instance were confined to the pelvis.

The cases cited are one reported by C. O. Bailey (Am. J. Roentgenol. **36:** 980, 1936); one by Beyer (Zentralbl. f. Chir. **69:** 781, 1942); two by Brunner (Deutsche Ztschr. f. Chir. **257:** 718, 1943).

Two roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Contrast Visualization of the Peridural Space (Peridurography). A Possibility of Recognition of Pathologic Changes in the Vertebrae and Intervertebral Disks. Klaus Albrecht and Willi Dressler. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 703–708, April 1950. (In German)

The authors emphasize the frequently unsatisfactory diagnostic results obtainable by use of the ordinary "flat" roentgenogram of the spine and by iodized oil myelography. The "flat" plate is diagnostic only in the rare cases where a calcified disk or a striking narrowing of the intervertebral space can be shown. Myelography, of undoubted value in the recognition of spinal tumors, encounters more and more criticism in the diagnosis of herniation of the nucleus pulposus; it has, besides, definite drawbacks due to the effect of iodized oils, which frequently cannot be satisfactorily removed from the spinal canal, even by operation. Air myelography does not furnish satisfactory radiographic or fluoroscopic contrasts, and air, like abrodil and other water-soluble media, is not free from untoward side-effects and complications.

Better diagnostic results have been obtained by the authors with the peridural injection of perabrodil, either through the sacral hiatus or by the lumbar route. In close analogy to the methods employed for peridural anesthesia, the following technic is recommended: The patient assumes the sitting position as for lumbar puncture. The injection site of choice is be-

tween L-1 and 2 or between L-2 and 3. After skin anesthesia and under continuous injection of sterile saline solution, the injection needle is advanced until the piston of the syringe follows the pressure of the finger practically without resistance. The tip of the needle lies now in the epidural space, and no spinal fluid must be seen escaping. In case of doubt regarding the exact position of the needle, 10 to 20 c.c. of air are injected. If this air injection does not result in headache, the position of the needle in the peridural space is secure. If the needle has accidentally entered the dural space, the procedure is abandoned. After ascertaining the correct position of the needle in the peridural space, 20 c.c. of a 35 per cent solution of perabrodil mixed with 15 c.c. of a 3.3 per cent solution of pantocain is injected in short time. The pantocain solution produces root anesthesia, without which the perabrodil injection is painful. The first roentgenograms are taken after five to ten minutes, preferably in the lateral and slightly oblique positions. The perabrodil is largely absorbed after twenty minutes.

Peridural air injections are considered of less value, or even dangerous due to the possibility of air embolism. It is conceded readily by the authors that their method—like all other methods available at present time—will visualize the highly important lumbosacral junctions in rare instances only. Experiments with air peridurography by American investigators (Sanford and Doub: Radiology **36:** 712, 1941) are mentioned.

Five roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Spondylarthritis in Children. Eugene L. Saenger. Am. J. Roentgenol. **64:** 20–29, July 1950.

The most important characteristics of spondylarthritis in childhood are the roentgenological changes. There is narrowing of the intervertebral space about two to four weeks after the onset of the clinical symptoms, with some demineralization or destruction of part of the vertebrae. The narrowing of the interspace persists for four to twelve weeks and beginning sclerosis of the vertebral body is seen. During the next two to eight months, there is gradual widening of the intervertebral space with sclerosis and new bone formation in the areas of destruction. In very young children there is a remarkable restitution to a near normal appearance within one year, whereas in tuberculosis similar changes occur at best only over a period of two or three years.

It is important that this syndrome be differentiated from tuberculous spondylitis. Differentiation is based on serial roentgenograms and clinical findings.

A specific etiological agent could not be demonstrated in the 4 cases reported. Trauma and low-grade infection appear to be causative factors in part.

In 2 of the author's cases, symptoms were referable chiefly to the hip. This "hip joint syndrome" due to disease of the lumbar spine (see Guri: J. Bone & Joint Surg. **28:** 29, 1946) should be considered whenever symptoms referable to the hip joint are present and no obvious lesion is found.

Thirty-six roentgenograms. DANIEL WILNER, M.D.
Atlantic City, N. J.

Air Myelography in Prolapse of the Vertebral Disk. J. Bücker. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 493–497, February 1950. (In German)

The author examined 60 patients with a clinical diagnosis of prolapsed disk by injecting air into the spinal canal, instead of jodipin or perabrodil. In 6 cases there was unquestionable evidence of prolapse, and in 5 the diagnosis was operatively confirmed.

For the examination the patient is placed in a 30-degree Trendelenburg position, and 50 to 60 c.c. of spinal fluid are withdrawn and replaced by air. The 5 cases which came to operation are briefly reported, and lateral views of the lumbar spine are reproduced, demonstrating the appearance of the air in the spinal canal and the characteristic thickening of the soft tissues in the region of the posterior prolapse, causing a narrowing of the lumen of the air sac in this area.

As long as we do not have a contrast medium that is without danger to the patient, the author recommends air injection, though this is useful only in the more advanced cases. Its diagnostic value is less in heavy patients because of the slight contrast between the injected air and the surrounding tissues.

Five roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Leukemia of the Spine in Childhood. Hans Hildebrand. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 709–713, April 1950. (In German)

Leukemic changes of the spine in childhood comprise both productive and destructive lesions. Bone destruction is largely represented by wedge-shaped deformity and osteoporosis of the vertebral bodies, which early become manifest in the roentgenogram. In pronounced cases, the vertebrae assume a biconcave shape, *i.e.*, the typical "fish vertebrae" appearance. The x-ray changes of the spine may precede the clinical manifestations by several months and so be of great importance in differential diagnosis.

Three illustrative cases are presented in detail.

Six roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

GYNECOLOGY AND OBSTETRICS

Cystographic Studies in Placenta Praevia. Max Dannenberg, Jacob S. Beilly, Marvin B. Rodney, and Charles Storch. Am. J. Roentgenol. **64:** 53–60, July 1950.

Cystographic studies are of distinct value in the diagnosis of placenta praevia. A group study comprising 72 cases is presented, and the following roentgenographic findings are listed for consideration in the diagnosis:

1. The head is high and deviated from the midline.
2. There is more than a 1 cm. spacing with a soft-tissue mass interposed between the presenting part and the superior border of the urinary bladder.
3. The bladder horns are asymmetrical. This finding is especially noted in marginal implantations. An oblique view is employed routinely by the authors, as the placenta may be marginal and at times can be visualized only in this view.

During the eighteen months prior to this report the authors had noted an additional roentgen sign, not heretofore described. "The bladder appears rigid and fixed. The usual concavity of the superior border of the contrast-filled urinary bladder may be subdivided to show several concavities; it may show indentations, angulation, serrations, or even be invaginated. This is probably explained by the fact that the low implanta-

tion of the placenta forces the thin lower uterine segment to encroach upon the posterior and superior aspect of the wall of the bladder, with the resultant extrinsic pressure defect."

The bladder roentgen sign has extended the usefulness of cystography in clinically suspected cases of placenta praevia with vertex and other presentations.

Fifteen roentgenograms; 1 table.

DANIEL WILNER, M.D.
Atlantic City, N. J.

THE GENITO-URINARY SYSTEM

Unusual Problems in Urologic Radiology. Walter L. Stilson and Paul H. Deeb. Urol. & Cutan. Rev. **54:** 325–330, June 1950.

Radiologic study of the urinary tract begins with careful preparation of the patient with castor oil, restriction of fluid intake, and cleansing enemas. Pitressin may be administered to remove residual gas shadows. The author enumerates various aids to diagnosis. Pressure over the bladder or the Trendelenburg position may be useful in intravenous urography. Careful inspection of films during the examination and individual variation in timing of additional films may add much important information. The use of larger quantities of dye and small cone localization over the kidneys is helpful in very obese patients. Oblique and lateral views with the catheter in the ureter help localize shadows close to or in the ureter. Films during respiration determine mobility of kidneys fixed by perinephritis. Air insufflation in Gerota's space aids in the diagnosis of extrarenal masses. Attention to the bony structures and bowel should not be overlooked.

Among the problems encountered is the presence of a large renal mass. This does not always mean carcinoma but may indicate a cyst or inflammatory process such as abscess. Urinary tract bleeding may be associated with pyelographic signs of tumor, as in the case of a patient who had been receiving dicumarol but, ten months after the original examination, was shown to have a normal kidney. The importance of repeated examinations is illustrated, also, by a case of aberrant vessel on the right and pain on the left. Following surgical correction of the condition on the right side, bleeding developed and restudy showed adenocarcinoma of the left kidney.

Ureteral displacement and obstruction may be produced by extra-urinary causes such as retroperitoneal tumor, especially lymphosarcoma. Ureteral obstruction and dilatation are a common finding with carcinoma of the cervix. These changes, frequently attributed to radiotherapy, are in general actually due to the tumor itself.

Faceted stones in a dilated redundant hydroureter low in the abdomen may be mistaken for gallstones. Ureteral stones may be non-opaque and if low in the ureter may lie in a transverse rather than a vertical position. Some ureteral stones are round and difficult to differentiate from phleboliths.

Tuberculosis of the kidney frequently involves the ureter, which shows a continuation of the irregularities seen in the renal pelvis. In other infections, the ureter may be dilated but is seldom irregular in outline. A notable exception is the bizarre appearance in ureteritis cystica. Tumors of the ureter are usually secondary to papillary carcinoma of the pelvis, though primary ureteral carcinoma has been reported and one such case is illustrated here.

Cystography may reveal unusual conditions, particularly if oblique and lateral views are made, as in one case cited, in which part of the dome of the bladder projected into a scrotal hernial sac. In vesicocolonic fistulae, barium studies of the colon may outline the fistulous tract more readily than cystograms.

The closest co-operation between urologist, radiologist, and clinician is urged if full utilization of the tremendous contributions of radiology to urologic problems is to be attained.

Twenty-seven roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Influence of the Blood Pressure in Urographic Examination. Preliminary Report. Ingmar Wickbom. Acta radiol. **34:** 1–5, July-August 1950.

The author believes that the blood pressure of patients undergoing intravenous urography should be taken before and after the injection of the dye. If there is a fall to about 70 mm. Hg, urinary function ceases and poor filling of the intrarenal structure results.

Two cases are reported. In each, 20 c.c. of 35 per cent umbradil was used and compression was exerted over the lower abdomen. The first patient was originally hypertensive, 210/115 mm. Hg. No visualization was obtained twenty-eight minutes after injection, and the systolic pressure was found to have fallen to 70 mm. After intravenous administration of 1.0 c.c. ephedrine the blood pressure rose to 150 mm. and two minutes later the renal pelves were well filled with the contrast medium. The second case was similar except that the patient was not hypertensive. The blood pressure fell to 55 mm. Hg and signs of mild shock ensued. There was prompt response to ephedrine (1.0 c.c.); the pressure rose to 95 mm. and good filling was demonstrated five minutes later.

The failure of secretion with a fall in blood pressure is on a physiologic basis. The author suggests the effects of compression of the aorta with reflex sympathetic action as the etiologic factor.

Five roentgenograms.

JOHN S. SCOTT, M.D.
Indiana University

Diagnosis of Hydatid Cyst of the Kidney. E. R. Reay and G. L. Rolleston. J. Urol. **64:** 26–52, July 1950.

Renal hydatid cysts are uncommon, comprising about 2 per cent of all cases of hydatid disease. The cyst is usually single and the only one in the body.

The changes occurring in the cyst during its development are described, and the importance of their recognition in the diagnosis is pointed out. Rarely does a renal hydatid cyst come to notice without a palpable tumor. This is smooth, rounded, and mobile, with a peculiar resilience. It must be differentiated from (1) polycystic disease and simple serous cyst, (2) malignant disease of the kidney, (3) hydronephrosis and pyonephrosis, (4) hydatid cyst of the liver, (5) tuberculous disease of kidney, (6) renal carbuncle, (7) renal stone, (8) acute abdominal conditions, (9) tumors of the spleen, and (10) tumors of the mesentery. Cases are reported illustrating the difficulties involved. Cystoscopy and retrograde pyelography are the final diagnostic procedures.

Multiple illustrations are included demonstrating irregularity of the renal outline, occasional "spider leg" pyelographic distortion, and examples of the typica

"wine glass" sign or crescent sign. The latter is present with pseudo-closed and open cysts. In the former the adventitia in the region of a calyx has been absorbed, together with the calyceal epithelium, so that the calyx communicates with a potential space between the laminated cyst membrane and the remaining adventitia. In the open type there is permanent or intermittent communication with the calyceal system.

Confirmatory laboratory findings include (1) eosinophilia, (2) a positive complement-fixation test, and (3) a positive Casoni test, dependent upon the local reaction to hydatid fluid in a sensitized patient.

Thirty-six illustrations, including 28 roentgenograms.

ROBERT F. CORKLE, M.D.
University of Pennsylvania

A Case of Pyelo-Ureteritis Cystica, Diagnosed by Pyelography. J. R. von Ronnen and H. Dormaar. Acta radiol. **34:** 96–101, July-August 1950.

Most reports of pyelo-ureteritis cystica are accompanied either by drawings of macroscopic preparations or photomicrographs showing the histologic changes, but no roentgenograms. The present report deals with a case diagnosed roentgenologically and 6 roentgenograms are reproduced.

The cystic changes in the renal pelvis, ureter, or bladder are thought to occur as the result of chronic infection. The cysts may be microscopic or macroscopic, above or below the mucous membrane. It is the macroscopic cysts which protrude above the mucosa that produce the changes demonstrable on the roentgenogram.

The authors' patient was a man of 35, complaining of slight pain in the left side and occasional reddish urine. There was tenderness to percussion and pressure in the left flank. Plain films showed nothing of significance, but intravenous pyelography revealed certain abnormalities on the left: (1) the renal pelvis was smaller than on the right side; (2) the outline of the pelvis and ureteropelvic junction showed small round and oval filling defects; (3) a mucosal pattern not unlike that of the gastric rugae was demonstrable. The findings on intravenous pyelography were confirmed by retrograde study. In the course of the latter procedure, after the pelvis was almost completely emptied of dye, oxygen was injected for double contrast, and a striking picture was obtained, showing the entire renal pelvis and first part of the ureter strewn with small round translucent spots surrounded by dilute contrast medium.

The literature mentions, in addition to the filling defects, (1) dilatation of the ends of the major calyces, with narrowing of the arms of the calyx below, and (2) cystic dilatation of the uretero-pelvic junction (Hinman, Johnson, and McCorkle: J. Urol. **35:** 174, 1936), but these features were not present in the case reported here.

W. LITTLE, M.D.
Indiana University

Calcification of the Vasa Deferentia. Poul E. Andersen. Acta radiol. **34:** 89–95, July-August 1950.

A case report is given of bilateral calcification of the entire vas deferens, the third in the literature. Twenty-five cases of segmental calcification have been reported, but the author does not believe this represents the true incidence. Four of the reported cases appear to be the result of chronic inflammatory processes and the remaining 21 presumably developed on the basis of degenerative processes. Of 9 cases reported by Marks and Ham (Am. J. Roentgenol. **47:** 859, 1942) 6 were in diabetics. No symptoms are present unless a stone in the duct produces spermatic colic and blood in the urine.

Calcification of the intrapelvic or inguinal portion of the vas deferens is manifested by double parallel lines of calcific density crossing the obturator foramen obliquely downward and medially.

The author's patient was an elderly man suffering from diabetes and arteriosclerosis. The extensive calcification was in the form of horns on either side of the midline of the pelvis pointing laterally upward and continuing in parallel lines taking a semicircular course laterally downward and medially across the obturator foramens and into the scrotum.

Two roentgenograms.

DAVID C. GASTINEAU, M.D.
Indiana University

THE BLOOD VESSELS

(See also The Head and Neck and The Chest)

Selective Phlebography of Deep and Communicating Venous Pathways of the Varicose Lower Extremity. J. Colin and A. Gersten. J. belge de radiol. **33:** 193–209, 1950. (In French)

The venous distribution of the lower extremity may be systematized in three segments: the network of the foot, the leg, and the thigh. In the foot the superficial veins open directly into the deep veins. In the leg the deep network consists of anterior and posterior peroneals, anterior and posterior tibials (frequently duplicated), and the tibioperoneal trunk. The superficial network contains the internal and external saphenous veins. At the upper end of the leg the external saphenous vein divides into two branches. The larger opens into the popliteal, and the other opens into the deep femoral vein. According to Rouvière, a superficial anastomosis connects the superior extremity of the external saphenous to the internal saphenous in a great number of cases.

In the thigh the deep plexus is a tributary of the femoral vein, which also may be duplicated; the superficial system is represented by the internal saphenous with its opening into the femoral, at the level of the fossa ovale. This presents numerous tributaries: a superficial group, the superior circumflex iliac, external pudendal and epigastric, and an inferior group, the lateral and medial superficial femoral veins.

In the leg and thigh the superficial and deep veins are connected by communicating veins.

For phlebography the patient's leg is placed in a dependent position. Tourniquets are applied just above the ankle and knee. A cannula is inserted into the internal saphenous vein just before the medial malleolus directed toward the great toe. Thirty cubic centimeters of 50 per cent umbradil is injected in fifteen to thirty seconds. The following films are then taken: an anteroposterior of the leg 15 seconds after completion of injection; lateral of leg at thirty seconds; anteroposterior of thigh at one minute; lateral of thigh at one and a half minutes after injection. It has been found that a delay of one minute in taking any of the roentgenograms scarcely affects the resulting study.

This method is not only of morphologic but also of physiopathologic value. In the normal subject, the

deep veins are well visualized; the tourniquets prevent filling of the superficial valves. If the valves are incompetent, the opaque medium passes through the communicating veins to outline the superficial veins. Varicosities are also well visualized. The valves are also demonstrable, and normal or abnormal position is noted. The muscles of the extremity must be relaxed, or communication may be noted in the absence of actual pathologic change.

[A similar method has been reported by Felder: Radiology **54:** 516, April 1950.—C. N.]

Fourteen roentgenograms; 5 drawings; 2 photographs.

CHARLES NICE, M. D.
University of Minnesota

X-Ray Demonstration of Traumatic Aneurysms. H. Angerer and A. Ravelli. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 718–722, April 1950. (In German)

For demonstration of a traumatic aneurysm, direct injection of the radiopaque medium into the aneurysm, supplemented by segmental vascular blockage, is recommended as the method of choice. Perabrodil or uroselectan B is used; thorotrast appears to be contraindicated. Not only does the procedure demonstrate the location and size of the aneurysm, but it frequently furnishes valuable information as to the aneurysmal and collateral circulation.

Five roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

RADIOTHERAPY

Radium Therapy of Primary Carcinoma and Other Malignant Lesions of the Vagina. Robert E. Fricke, Harry H. Bowing, and David G. Decker. Am. J. Roentgenol. **64:** 86–93, July 1950.

A total of 50 cases of primary malignant lesions of the vagina have been observed at the Mayo Clinic from 1930 through 1948. The diagnosis of primary vaginal carcinoma is said, by many authors, to be simple. This may be true, but differentiation from secondary involvement of the vagina by a malignant lesion arising elsewhere is often most difficult.

The dosage and technic of treatment of cancer of the vaginal wall are difficult to describe because the variations in the lateral extent and depth of the lesions and their variable location in the vaginal cavity make each case a separate study. Probably the entire growth should receive 4,000 to 6,000 gamma roentgens over a period of one to two weeks. Infiltrating lesions may be covered with plaques of radium tubes for a dose of 60 to 90 mg. hr. per square centimeter of tissue. If the lesion is medullary, protruding into the vaginal cavity, further dosage is usually supplied with radium needles or seeds, in addition to the surface treatment, to yield sufficient gamma roentgens to the depth of the growth. In addition, if the lesion of the vaginal wall is near the cervix, radium tubes are inserted into the cervical canal for substantial dosages. This seems desirable because these rapidly growing, high-grade lesions tend to spread over the cervix and into the cervical canal.

The applicator for direct contact with the lesion consists of two or three 1.0 mm. platinum-walled tubes containing 50 mg. of radium sulfate (element), encased with 2.0 mm. of Para rubber, strapped together side to side. The vaginal fornices are irradiated with an applicator consisting of a standard 50-mg. platinum tube encased in 1.0 cm. of Para rubber or bakelite, the whole covered with a rubber finger cot. The cervical applicator consists of the standard 50mg. platinum tube, which either is used in the cervical canal or may be implanted directly into a necrotic tumor mass. The intrauterine tandem, if used, is usually made of two standard platinum tubes end to end, enclosed in a 1 mm. brass sound. Radon seeds of 1.0 millicurie each may also be implanted in the tumor.

Supplemental roentgen therapy is started a few days after completion of the radium therapy. Usually the pelvic area is divided into two anterior and two posterior ports, 16 × 16 cm. The factors used are 200 kv., 20 ma., 50 cm. distance, 20 minutes, with a filtration of approximately 0.75 mm. of copper and 1.0 mm. of aluminum; 500 r in air are delivered to each field. In some cases divided dosage may be used. If the lesion is extensive, a second course of roentgen therapy is given three months after the first.

There has been a gradual improvement of the survival rate of patients with primary malignant lesions of the vagina seen at the Mayo Clinic. This has coincided with the improvement in radium therapy technic and with an increased experience with this type of lesion. However, there is no doubt that this is a highly malignant lesion and one most difficult to treat. Perhaps the most important fact is that many patients with far-advanced lesions received very adequate palliation from radium and roentgen treatment. Thus they could live without too much discomfort, although cure was impossible.

The value of a periodic pelvic examination for women in and past the menopausal age group must be stressed. The early recognition of vaginal cancer would undoubtedly lead to a much higher salvage. Finally, even innocent appearing vaginal lesions should be subjected to microscopic examination.

Eight tables.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Treatment of Hodgkin's Disease with Roentgen Irradiation and Nitrogen Mustards. Frank H. Bethell, Gould A. Andrews, Rosalie B. Neligh, and Muriel C. Meyers. Am. J. Roentgenol. **64:** 61–73, July 1950.

A series of 173 cases of Hodgkin's disease has been studied with reference to therapy and the factors influencing the length of survival. Roentgen therapy was employed in 138 cases. More recently nitrogen mustard compounds have also been used. Of 119 patients receiving roentgen irradiation for whom adequate information was available up to death or for a five-year period, 19.3 per cent were alive five years after the diagnosis was made. About 5 per cent survived ten years. Thirty patients were treated by nitrogen mustards. Of 16 with advanced generalized lesions, 9 showed satisfactory control for at least six months but in 6 of these irradiation therapy was also given. In 6 cases of acute, rapidly progressive disease, there was transient dramatic relief of symptoms but little or no apparent effect on the duration. Three illustrative cases are reported and the following therapeutic conclusions are drawn:

Complete eradication of the disease when it is apparently well localized and accessible may reasonably be hoped for, but is rarely accomplished. Surgical excision of a single group of nodes, although it may fail to eliminate all Hodgkin's tissue, is often followed by a better effect from irradiation than would otherwise have been expected. In any event, surgery alone should never be considered an adequate form of therapy, and should always be followed by irradiation.

Roentgen irradiation is the most satisfactory form of therapy in localized and early cases of Hodgkin's disease. It should be given energetically to all regions of the body in which there is evidence of involvement and should be repeated wherever there is evidence of local recurrence.

In the more advanced cases combined roentgen irradiation and nitrogen mustards may give better results than either alone. Lymph node enlargements are usually best treated with roentgen irradiation. Systemic manifestations, such as profound fatigue, anorexia, fever and pruritus, may be advantageously controlled with nitrogen mustards, but consideration should also be given, in such cases, to retroperitoneal irradiation.

Osseous involvement is usually best treated with roentgen irradiation. Pleural effusion is an indication for irradiation to anterior and posterior mediastinal areas. Diffuse central nervous system involvement may be temporarily benefited by nitrogen mustard therapy.

Nitrogen mustard is of especial value in the treatment of advanced cases of Hodgkin's disease, those with extensive visceral involvement, and those in which post-irradiation tissue damage is present or anticipated.

The use of alternate courses of roentgen irradiation and nitrogen mustard therapy has distinct promise in the management of Hodgkin's disease.

Because of its depressing effect on normal bone marrow, nitrogen mustard should always be given with caution and realization of its potential danger. Nevertheless, the contraindications to its use are few.

Of the more common physical signs, enlargement of the spleen in the early course of the disease is considered of most unfavorable prognostic significance. A leukocyte count below 6,000 per cu. mm. is usually indicative of a poor prognosis, although patients with counts above 10,000 per cu. mm. also tend to succumb to their disease earlier than those with normal leukocyte levels.

Twelve roentgenograms; seven tables; two graphs.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Hodgkin's Disease and Pregnancy. Report of Four Cases. U. V. Portmann and B. E. Mulvey. Cleveland Clin. Quart. **17:** 149–153, July 1950.

Four cases of Hodgkin's disease associated with pregnancy seen at the Cleveland Clinic between 1930 and 1949 are reported. With such an unpredictable condition as Hodgkin's disease, it is difficult to draw conclusions as to the effect of pregnancy, but these cases, while they present no constant pattern, nevertheless call attention to the fact that pregnancy may result in exacerbation of this disease.

One patient had had Hodgkin's disease for seven years with no exacerbations. She then became pregnant, her condition grew progressively worse, in spite of roentgen therapy, and death ensued in about two years. Autopsy showed Hodgkin's sarcoma, though the original diagnosis had been Hodgkin's granuloma. The second patient died undelivered of a six-month fetus, having had symptoms of the disease for a year but no irradiation. In the third case manifestations of the disease appeared shortly after delivery of the patient's first child and there was probable exacerbation during a second pregnancy in the third year of the course. Roentgen therapy controlled the severe pruritus and the patient was still alive at five years but in very poor condition. In the last case symptoms dated back two years, having appeared during pregnancy. The patient was alive at the time of the report, but with mediastinal and cervical nodes for which irradiation had been advised.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgen Therapy of Cavernous Hemangiomas. Report of a Case Complicated by Secondary Infection. John H. Juhl and Ernst A. Pohle. Wisconsin M. J. **49:** 585–588, July 1950.

In the State of Wisconsin General Hospital, most hemangiomas are treated with radium, but there are certain large lesions which lend themselves to roentgen therapy because of their size and location. It is possible in these cases to get more even distribution of roentgen rays than of beta and gamma rays of radium, thus avoiding the irregularity and blotchiness which may follow uneven therapy when radium is used on large areas. It also eliminates the possibility of overlapping in some cases.

The depth of the tumor is the determining factor in selecting the quality of radiation used. For relatively superficial hemangiomas the authors use 130 kv., with 0.25 mm. of copper plus 1.0 mm. of aluminum. A dose of 150 to 200 r in air is administered at intervals of two weeks for a period of three to five treatments. For large deep cavernous nevi, treatment is given at 175 kv., with a filter of 0.5 mm. of copper plus 1.0 mm. of aluminum.

In the case reported, in a girl aged four months, a large cavernous hemangioma almost completely surrounded the lower forearm and wrist, extending from the level of the first metacarpophalangeal joint upward to involve the lower third of the forearm on its lateral, dorsal, and ventral aspects.

A series of four treatments, 200 r in air each, was given, with intervals of two weeks. An anterolateral and a posterolateral portal were used. Radiation was generated at 130 kv., filtered with 0.25 mm. of copper plus 1.0 mm. of aluminum. Approximately two weeks following the completion of the treatment the child fell and injured the arm at the site of the lesion. An infection followed with ulceration of the major portion of the area involved by the hemangioma. As the ulceration healed under treatment, regression of the hemangioma took place. Nine months later it had disappeared.

The authors believe that the secondary infection which occurred in this case contributed to the final good result. They have observed this in a sufficiently large number of patients to become convinced that secondary infection may hasten the disappearance of the lesion. They also feel that hemangiomas secondarily infected at the time treatment is started require smaller doses than non-infected lesions. They state that in twenty years not a single instance of growth retardation was encountered with the technic outlined here.

Eight photographs

ALFRED O. MILLER, M.D.
Louisville, Ky.

Treatment of Simple Epithelial Cysts with Secondary Photo-Electron Radiation. Preliminary Report. Lionel Cohen and Samuel A. Kimmel. Brit. M. J. **2:** 87–88, July 8, 1950.

Conventional roentgen therapy was found to be completely ineffective in the treatment of cystic swellings in the neck which had originated as ranulas in the floor of the mouth and had extended into the neck. Because surgical removal and injection of sclerosing agents were also unsatisfactory forms of treatment, the authors were prompted to attempt an alternative form of radiation therapy. This consists of aspiration of the contents of the cyst, and the introduction of 2 c.c. of 10 per cent aqueous suspension of bismuth oxychloride ("bisoxyl"). Intermediate-voltage radiation is then delivered to the tissue, 300 r (air) at a single sitting.

The high photo-electric emission from the irradiated heavy metal produces intense local ionization limited to a distance of a few microns in tissue, so that only the epithelial lining of the cyst is affected. The response to this procedure has been uniformly good, and within three weeks all that remains of the cyst is a small fibrous nodule. Hospitalization is necessary only during the first week. Four selected cases are presented.

Two illustrations. GABRIEL WHITEMAN, M.D.
University of Louisville

Beta Ray Uses in Ophthalmology. Albert D. Ruedemann. Wisconsin M. J. **49:** 581–584, July 1950.

The author reports various experiences in the use of contact x-rays, radium-D, and radon screened by a glass tube to give 97 per cent beta rays and 3 per cent gamma radiation. Heavy dense lesions of the lid are best treated by a contact x-ray therapy and gamma rays. Radon is the treatment of choice in corneal lesions, particularly in children, as the treatment time is shorter.

Objectionable epithelial overgrowths along the lid margin can be treated with contact roentgen irradiation, gamma rays, radon, or radium-D. The type of lesion that responds rapidly to radium is a superficial corneal overgrowth that has capillaries with superficial vessels going into the cornea.

The polypoid degeneration of the lid in vernal catarrh has been successfully treated with the gamma rays or contact x-rays. It is important to treat the small isolated polyps on the undersurface of the lid as they cause discomfort and possible corneal scarring.

Corneal nebulae produce loss of vision out of all proportion to their density. These are easily treated by radium, and improvement in the vision nearly always occurs.

Vascularities of the cornea and other marginal overgrowths such as pterygia have also been successfully treated.

The author mentions many other lesions which have been treated with various types of radiation, but makes little mention of dosage, number of treatments, or intervals between treatments. ALFRED O. MILLER, M.D.
Louisville, Ky.

RADIOISOTOPES

Role of Radioisotopes in Blood Dyscrasias and Neoplastic Diseases. Howard B. Hunt. Texas State J. Med. **46:** 496–503, July 1950.

The author's experience with radioisotopes has been limited primarily to radioiodine and radiophosphorus, which he has found applicable in about 2 to 4 per cent of patients seen in consultation with regard to radiation therapy. A radioisotope service can be set up for as little as $1,000 or as much as $50,000. A committee, preferably including a radiotherapist, internist, hematologist, and physicist, should be organized under the sponsorship of a local medical institution and the program must be approved by the Atomic Energy Commission before the isotopes can be obtained.

In diagnosis, radiophosphorus has been used for the differentiation of benign and malignant breast tumors, but the limitations of the method are too great for it to replace biopsy. Radiophosphorus has also been used to detect brain tumors but with unsatisfactory results in deep-seated and cystic lesions. More promising work on brain tumors is being done with radioiodine incorporated in diiodofluorescein. This gives a penetrating gamma ray and also a fluorescence under ultraviolet light. Radioiodine is better known for its use in the diagnosis of metastases of functioning thyroid cancer and in evaluating the state of thyroid function.

Therapeutically radiophosphorus is used for total body irradiation in polycythemia vera, chronic leukemia, and rarely in other disseminated neoplastic diseases. In the treatment of leukemia it serves best as an adjunct to roentgen therapy.

In the treatment of thyroid cancer radioiodine is of limited value. It is advantageous only in a small selected group of thyroid neoplasms, namely, those by which it is significantly concentrated and which are complicated by non-resectable extension or metastases. Radioiodine is an adjunct in the treatment of certain metastatic functioning carcinomas of the thyroid, but does not replace conventional irradiation by roentgen rays and radium.

Radiostrontium is an effective source of beta rays and has been used for surface applicators. Its use, however, is attended by serious hazards. Grenz rays are equally advantageous and less dangerous.

Radiosodium, like radiophosphorus, has been used for total body irradiation but is far more hazardous to the therapy staff than roentgen irradiation and is attended by serious side-effects. It is primarily useful as a research tool.

Radiocobalt holds promise as a substitute for radium, emitting gamma rays of 1.1 and 1.3 megavolts and a readily absorbed beta ray of 0.31 megavolt. It provides little or no real advantage in intracavitary or interstitial irradiation to radiologists already equipped with proper radium applicators. Teleradiation by radiocobalt provides such advantages in deep therapy as are inherent in 1,300,000-volt radiation.

Finally radiogold has been used to infiltrate malignant tumors and the surrounding tissues, but it is hazardous to the operator and its distribution is spotty and unverifiable.

In research many isotopes are being used to study intricate chemical processes in metabolism and undoubtedly will eventually bring about important discoveries.

Four tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radio-iridium Teletherapy. H. F. Freundlich, J. L. Haybittle, and R. S. Quick. Acta radiol. **34:** 115–134, July-August 1950.

The authors have investigated Ir^{192} as a gamma-ray source for a teletherapeutic unit. One of the requirements for a radioisotope to be used in such a unit is a half-life long enough to insure a continuous service without undue complications. This requirement is met by having two identical iridium sources per unit, one in use while the other is being reactivated in the pile. In one month an Ir^{192} source decays about 25 per cent, but allowance can be made for this loss in calculating the treatment time.

The radioactive iridium is made up in four rings of 0.1 mm. thickness, mounted on aluminum bases. These rings are enclosed in an aluminum cylinder, the front face of which is 1.0 mm. thick. The weight of the therapy unit is 50 lb , and it permits an output of about 11 r per minute at 8 cm. F.S.D. The lead protection is sufficient to make pneumatic control unnecessary.

Measurements were made of protection, absorption, and dose distribution, and these matters are discussed in some detail. Photographs of the unit and of the iridium rings are included, as well as graphs, isodose charts, and tables.

W. L. BRIDGES, M.D.
Indiana University

Metabolism of Radioactive Dibromoestrone in Man. Gray H. Twombly and Erwin F. Schoenewaldt. Cancer **3:** 601–607, July 1950.

The clinical observations reported here supplement earlier experimental findings (Am. J. Obst. & Gynec. **56:** 260, 1948. Abst. in Radiology **53:** 155, 1949) which showed (1) that in rabbits, dogs, and monkeys there was no selective absorption of dibromestrone by the uterus, and (2) that a large proportion of the steroid was excreted promptly in the bile.

Dibromestrone labeled with Br^{82} was injected into 11 patients. From 8 of these patients bile was collected at intervals from drainage tubes inserted in the common bile duct following operation for chronic cholangitis or common duct stones. In the 3 remaining patients, operations (radical mastectomy, hysterectomy) were performed twelve hours after administration of the steroid. It was found that the biliary system was the principal route of excretion of the steroid, 39 per cent of the radioactivity being found in the bile as compared to 18 per cent in the urine. There was no evidence of selective localization of dibromestrone in the breast or uterus.

Two tables and 2 graphs are included.

J. G. LORMAN, M.D.
Indiana University

RADIATION EFFECTS

Roentgenotherapeutic Changes in the Small Intestine. Surgical Aspects. Horace M. Wiley and Everett D. Sugarbaker. Cancer **3:** 629–640, July 1950.

Severe damage to the small intestine was encountered in 9 of 600 patients treated by roentgen therapy for carcinoma of the uterus. The average time elapsing between radiation treatment and the development of incapacitating symptoms was twenty-six and a half months. All but two cases reached a stage of partial or complete intestinal obstruction. Factitial reaction of the small bowel seemed to occur only in small thin women as a result of more effective depth doses of radiation on the lower small bowel. ("Factitial," as used here, implies that the reaction was unintentionally produced but was unavoidable. See editorial by Leucutia: Am. J. Roentgenol. **53:** 180, 1945.) These patients presented themselves for treatment from five to sixty months after irradiation, complaining of tarry or bloody stools, anorexia, episodes of abdominal cramping and distention, vomiting, diarrhea, marked weight loss, and anemia. The differentiation of this syndrome from recurrent or metastatic carcinoma is aided by the finding of a factitial proctitis. A small bowel roentgenographic series or barium enema study shows a picture similar to regional ileitis with ileal narrowing in some areas and dilated loops with puddling of barium in others.

The lesions involve only those segments of small intestine having a sufficiently long mesentery to allow them to enter the pelvic zone of radiation. The rectum, sigmoid, and cecum are also frequently involved. The peritoneum is lusterless and thickened. Obstruction is usually in the distal ileum. The injured bowel is thickened, edematous, inflexible, telangiectatic, and avascular. Fixation of loops in the pelvis, with mucosal ulceration, necrosis, perforations, and peritonitis, is often found. There are fibrosis and scarring of the bowel wall, which may be marked enough to cause stricture. These changes produce chronic bleeding and impaired absorption, resulting in progressive anemia and malnutrition.

Seven patients required surgical intervention, chiefly for obstruction. The authors advise preoperative transfusion and Miller-Abbott tube decompression, followed by a simple side-tracking anastomosis between healthy loops of intestine. The Mickulicz double-barrel ileocolostomy is the procedure most frequently used and offers the advantages of extraperitoneal anastomosis, putting the large bowel at rest, and immediate decompression. Resection of the damaged bowel is usually contraindicated because of the poor condition of the patient. Six of the authors' 9 patients died, and the 4 upon whom autopsies were done showed no residual carcinoma. Two were still living seven months and five years, respectively, following surgery. [These figures are as given in the text and seem to be in accord with the case histories. In an accompanying table the survival periods are given as three years and five years, respectively, and in the authors' summary as seven months and six years—ED.] One is still being treated medically.

This report is recommended to all radiotherapists.

Three illustrations, including 1 roentgenogram; 1 table.

J. A. CAMPBELL, M.D.
Indiana University

Modification of Resistance to Ionizing Radiation by Humoral Agents. J. B. Graham and R. M. Graham. Cancer **3:** 709–717, July 1950.

A number of agents which have been demonstrated experimentally to augment or retard the radiosensitivity of tumor and normal tissues are reviewed. The effects of several humoral agents injected into Swiss mice with subsequent total body irradiation (400 r) were studied by these authors. Proper controls were used and unrelated factors were kept constant. The radioresistance

of the experimental rodents depended upon the type and dose of the agent given, and the time of administration in reference to the time of irradiation.

The results indicated that horse serum (foreign protein) administered before irradiation protected both males and females, but had little effect when given in the post-irradiation phase. Estradiol benzoate produced similar effects, rendering both male and female more resistant when given before irradiation. Estrone administered before irradiation protected females, but stilbestrol was without effect in females. In males, stilbestrol increased the mortality rates when given prior to irradiation but appeared to offer some protection when given post-irradiation. Testosterone had a deleterious influence when administered following irradiation in females. Adrenal cortical extract protected both males and females when given in small doses before irradiation but was harmful in females when given afterward.

The irregular pattern produced by the gonadal hormones indicates that radiosensitivity is not a primary gonadal activity. However, the investigators produced 100 per cent mortality by irradiation of ovariectomized mice as opposed to a 48 per cent mortality in irradiated control mice, which suggests a significant role of the gonads in modifying the effects of ionizing radiations.

A study of the adrenal cortex and the effects of adrenal cortical extract disclosed that this structure had little concern with the resistance to radiation, although its activity and size were directly responsive to ionizing rays.

It was noted that vaginal smears from the irradiated mice showed the same cytologic changes as vaginal smears of women being treated for cervical carcinomas. Also, the cellular reactions demonstrated on oral, rectal, and vaginal smears from the irradiated mice paralleled the subsequent mortality rate. Thus a study of the cellular reactions of the normal tissues is an index to radiosensitivity and is of prognostic value. The alterations in cellular composition could be duplicated by injections of various non-toxic agents into the mice; this cellular alteration the authors label a "sensitization response." The mice showing the greatest incidence of sensitization response had the highest mortality when subsequently exposed to ionizing radiation, indicative of a summation effect. Neither the ovaries nor the adrenals were essential for the production of the sensitization response.

The authors conclude that the radiocurability of cancer is related to the common sensitivity of the normal and abnormal tissues, and that the response of the normal tissue is of prime importance prognostically.

Three tables.

J. W. WILSON, M.D.
Indiana University

Ill Effects of the Radium Menopause. Hugh C. McLaren. Brit. M. J. **2:** 76–80, July 8, 1950.

This is a follow-up study of 118 women between the ages of 33 and 58 who received 2,400 mg. hours of intrauterine radium for non-malignant uterine bleeding.

The commonest symptom following irradiation was flushing, which occurred in severe or moderately severe form in 49 per cent, as compared with 17 per cent following a natural menopause. (With surgical castration the incidence is 46 per cent.) Spontaneous cure of the flushing occurred in only 25 per cent of 71 patients followed for an average of two years.

The effect of the radium on libido was studied in 143 cases. Of 77 patients estimated to have had normal sex urge previously, 55, or 71 per cent experienced partial or complete loss of libido. Out of 126 cases studied for effect of radium on orgasm, only 65 or 51.6 per cent had normal orgasm prior to radium. Following radium, 57 per cent of these patients suffered partial or complete loss of normal genital sensation. Dyspareunia was present in at least 10 per cent, occasionally aggravated by lack of normal vulvar secretion.

Changes in the genital tract occurred soon after irradiation. Senile vaginitis, as indicated by bleeding mucosal spots, occurred in 16 per cent, as compared with none following simple hysterectomy. However, following normal menopause, the incidence of bleeding spots was 26 per cent. Atrophic changes were also noted in the cervix, which decreases in size, and secretes little or no mucus. The radium menopause will thus cure an unhealthy cervix, and relieve discharge from it.

Although the treatment of non-malignant uterine bleeding with x-rays or radium is safe and simple as compared with hysterectomy, it is obvious from this investigation that certain undesirable results occur: flushing, loss of libido, and premature involution in the genital tract. Therefore, simple measures should be tried first. If irradiation is found necessary, the patient should be followed for at least three years and the symptoms treated with stilbestrol.

Three tables.

GABRIEL WHITEMAN, M.D.
University of Louisville

Use of Radon Ointment in the Treatment of Post-Irradiation Ulcers. Paul E. Repass. Rocky Mountain M. J. **47:** 432–434, June 1950.

At the University of Colorado Medical Center the use of radon ointment has been limited to chronic post-irradiation ulcers showing no sign of healing after several months of other therapy.

Eight cases are reported, the number of weekly treatments per case ranging from three to twenty-five. Three cases involved the nose, 2 the lower lip, 1 the ear, 1 the scalp, and 1 the pre-auricular region. The original radiation treatment was for basal-cell, squamous-cell and mixed basal- and squamous-cell carcinomas. In 2 cases the ulcer healed well; in 4 there was reduction in size of the ulcerated area, but recurrent epithelioma was present in the ulcer margin, necessitating further x-ray treatment; and in 2 cases the ulcers improved under treatment but skin grafting was advised due to presence of extensive thick scar tissue.

Some experimental work indicates that the capillary bed of the tissues treated is increased by the action of radon directly. This action is particularly important in the chronic indolent type of ulceration where the blood supply is known to be poor. Radon ointment will sometimes produce a mild erythema and the author's observations are that these old ulcers frequently bleed easily as healing begins.

One table.

HARRY HAUSER, M.D.
Cleveland City Hospital

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